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DEPARTMENT EDUCATION ALBERTA

Programme of Studies For The High School

Bulletin IV

Prescribed Courses
IN
HEALTH and PHYSICAL EDUCATION
and in SCIENCE
INCLUDING

BIOLOGY 1 and 2
CHEMISTRY 1 and 2
GENERAL SCIENCE 1 and 2
GEOLOGY 1
PHYSICS 1 and 2

Additional copies of this Bulletin may be had from the General Office of the Department of Education at 10 cents the copy.

Edmonton: Printed By A. SHNITKA, King's Printer.
1939

NOTE TO THE TEACHER

The revised course in high-school English makes every teacher a teacher of Language. The students' skill and correctness in oral and written Language is the concern, not only of the teacher of English, but also of the teacher of Social Studies, Science, Mathematics and all other subjects. A special check-list of language errors will be found in the outline for the course in Language.

Students whose written work is deficient in penmanship, spelling and form will be debarred from admission to the Alberta Normal Schools.

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HEALTH AND PHYSICAL EDUCATION

"An adequate education will include worthwhile experiences in **health, physical education** and **recreation.** Not only the concept of unity of the organism but also the clear recognition of the interrelations between organism and environment requires that this education, if it is to be adequate, must concern itself with facilities, programme and leadership. This may be accomplished through the development of (1) a comprehensive health protection programme for students, including an adequate health examination, control of communicable diseases, and healthful school living in the entire curricular and extra-curricular life of the school, directed toward the educational goal of developing capacity for self-direction in health matters.

(2) Health instruction based on scientific materials progressively arranged throughout the grades, directing students toward vigorous health, and not merely toward freedom from disease. Safety should be included in this instruction.

(3) Opportunities for the development of skills and interests in recreational hobbies that will persist and contribute to healthful and happy living after students have left school."

—Adapted from the platform of the "American Association of Health and Physical Education."

HEALTH AND PHYSICAL EDUCATION 1

The course in Health and Physical Education 1 is compulsory for all High School students. Of the three periods per week, **two** should be given to Physical Education and **one** to Health. In some schools it will be necessary to vary this arrangement—until a gymnasium or a rented hall can be secured, by devoting all periods to Physical Education out of doors during suitable weather, and to Health instruction in the class-room at other times. Girls and boys are to receive their training and instruction **in both sections of the course in separate groups, and from teachers of their own sex.** This may require some re-arrangement of staff personnel and duties.

A. Health Education.

The course in *Health Education* which follows comprises *four* themes.

If sufficient time can not be found for all four of the themes, the class should take Themes I and II, and either Theme III or Theme IV.

THEME I.—GROWTH AND DEVELOPMENT.

Problem I.—How the body is made.

(1) All living things are made of cells.

Compare the structure of organic matter and inorganic matter.

Discuss the theory that all substances are made of molecules and atoms.

Develop the meaning of an element and a compound.

(2) Plant and animal cells are similar in structure.

By means of drawings compare the structure of plant and animal cells.

(3) All cells are composed of protoplasm, an exceedingly complex chemical compound.

From various books find out what you can about protoplasm.

What are some of the constituents of protoplasm?

(4) Protoplasm has definite properties: (a) it can reproduce; (b) it can grow; (c) it can obtain and use food; (d) it can eliminate waste; and (e) it can send messages.

Study the amoeba to discover the properties of protoplasm.

Give examples to show that the protoplasm of our cells possesses these properties.

(5) Many-celled organisms develop cells to do special work.

Explain the need for special cells; as bone cells, muscle cells, gland cells, etc.

(6) All tissues in the body develop from five different kinds of cells: (a) epithelial cells; (b) muscle cells; (c) connective cells; (d) nerve cells; and (e) blood cells.

Make drawings of the various kinds of cells in the body. Show how each type of cell is adapted to do special work.

(7) Cells of the same kind are grouped together to make a tissue.

Name several tissues in the body. Obtain a cut of meat from the butcher shop and examine it to discover various kinds of tissues—skin, blood, bone, muscle, etc.

(8) When several kinds of tissues are grouped together to perform a definite function, we speak of them as an **organ.**

List the various kinds of tissues in an organ such as the eye, the heart, the stomach. Explain the work of each tissue in these organs.

(9) Many organs function together to perform definite body processes. We speak of these organs collectively as a system.

Analyze one or two systems, such as the digestive or circulatory, to discover what organs function together to accomplish a special piece of work.

(10) If one system does not function properly, it interferes with the work of others.

Show how illness or injury of one part of any system interferes with the health of the body as a whole; e.g., a cold in the head may affect digestion; an infected foot may cause increased heart beat, loss of appetite, rapid breathing, etc.; diabetes, a disease of one organ, disturbs the functioning of various parts of the body.

Problem 2.—How we began.

(1) Early scientists believed that life developed spontaneously; e.g., Aristotle, Bacon. Pasteur proved that life must come from life.

By reference to an encyclopaedia or a science textbook, try to discover some of the early beliefs regarding the origin of life.

Read the life of Pasteur to discover how he proved that all organisms have parents like themselves.

(2) Simple forms of life reproduce by cell division, by budding, by spore formation. They are known as asexual organisms.

Read, in a textbook on Biology, about the reproduction of the yeast plant, of moulds and of bacteria.

(3) Reproduction in higher forms of life is carried on by special sex cells and by means of two parents.

Read, in a textbook on Biology, about the reproduction of the fish.

Can a reason be given for the fact that the higher forms of life reproduce by two parents.

(4) Higher forms of life have special reproductive organs.

N.B.—There are obvious difficulties for the teacher in this topic. Where boys and girls cannot be taught separately, it will be sufficient to have in the classroom for reference a good textbook that explains the reproductive system; such as *The Human Body,* by Best and Taylor, or *Hygiene for Students and Teachers,* by Eastwood.

Problem 3.—Heredity.

(1) Sex cells are similar in structure to body cells except that they carry the hereditary qualities of the species.

Make a drawing of a sex cell, showing *nucleus* containing *chromatin* and *centriole.*

(2) Sex cells divide in a very definite manner.

By drawings, show steps in cell division: (a) the centriole changes; (b) the chromatin becomes chromosomes; (c) the chromosomes split longitudinally and move to each side of the cell; (d) the cell divides; and (e) two daughter cells appear, similar to the original cell.

(3) Chromosomes are the vital part of the sex cell. It is believed that they are composed of *genes,* microscopic bodies which are responsible for carrying the characteristics of the species. The number of chromosomes is fixed for each species.

Explain the significance of the chromosomes. Have the class understand how we get our inheritance. Human beings have 48 chromosomes, 24 from the mother and 24 from the father.

(4) Heredity means that certain characteristics or qualities are carried from parents to offspring by means of the genes in the chromosomes.

Explain Mendel's principle of dominant and recessive characteristics.

Discuss characteristics that are inherited by human beings.

(5) Eugenics is a study of the laws of inheritance as applied to to the human race.

Discuss the meaning of a good inheritance. Show that desirable qualities as intelligence, perseverance, special abilities seem to 'run' in families. Show also that feeble-mindedness, irresponsibility and shiftlessness have appeared again and again in certain families.

(6) Heredity is an extremely important factor in health.

Emphasize the fact that diseases are not inherited; but that we do inherit a bodily set-up which is resistant or suseptible to certain diseases. Discuss a disease such as tuberculosis, explaining that several members of a family may develop the disease, not because they inherit it, but because they may infect one another by contact. Probably the family has not a high resistance to disease.

Show that stature, temperament and other inherited characters, affect one's disposition to health or disease.

(7) Healthful living overcomes handicaps in heredity.

Discuss the fact that people who inherit a somewhat delicate constitution can become strong and vigorous by right living, as did Theodore Roosevelt. Individuals who may be susceptible to tuberculosis can build up a high resistance by plenty of rest, good nutrition, out-of-door exercise, etc.

References for Theme I:

Hygiene for Students and Teachers: Eastwood (Macmillan Co.).
The Human Body: Best and Taylor (Gage Co.).
Growing Up: de Schweinitz (Macmillan Co.).

Sex for Parents and Teachers: Stowell (Macmillan Co.).
The Adolescent Girl: Richmond (Macmillan Co.).

THEME II.—PERSONAL EFFICIENCY.

Problem 1.—How to develop one's personality.

(1) Life is a quest for happiness for ourselves and for others. Two of the most important factors fundamental to happiness are *mental health* and *physical health.*

What are the qualities of good mental health which distinguish it from poor mental health?

Discuss the desirability of understanding one' self and one's motives; of possessing good habits of working, playing, thinking, feeling; of being able to make friends easily; of developing wholesome interests; and of adjusting one's self to the world of people and objects about him.

(2) It is important to understand one's *motives.* Every organism has appetites, "drives" or urges to satisfy. Some of these are natural or constitutional; as the appetite for food, sleep, sex, and contact with others. Other appetites seem to be acquired; as the desire for approval, and the desire for achievement.

List a number of *appetites* which appear independently of learning.

Discuss some of the acquired appetites. Should all appetites be satisfied directly and immediately?

How are appetites to be modified or redirected?

(3) It is necessary for us to know what are good *habits,* and what are bad, in achieving sound mental health.

Many habits are modes or mechanisms of adjustment in the satisfaction of drives.

Discuss a few of the more common mechanisms: compensation, identification, escape reactions, defense reactions, regression, rationalization, projection.

Find illustrations of these devices in history, in literature or in every-day life.

Consider how they should be corrected.

Is it possible for a dominating person to have a weak personality?

(4) The inordinate use of alcohol is often associated with quirks or weaknesses of personality.

Is the habitual or occasional drinking of alcohol related to any of the mechanisms discussed in the preceding section?

Discuss the following reasons given by young people who have formed the habit of drinking beverage alcohol: (a) For the sake of sociability. (b) To be smart; —all the "best people" serve cocktails. (c) The pressure of the social group. (d) Stimulation required to keep the pace. (e) To escape from facing unpleasant situations. (f) To cover up what one considers personal shortcomings.

Examine the statement: "I can take a drink or leave it alone."

(5) It is essential to be well adjusted socially. Much of present-day life is social life, and human beings constitute a large part of one's environment.

What is the basis for sound friendship?

What are some home responsibilities that young people should shoulder?

Can a procedure be found for learning to control one's temper?

One forgets a grudge in an "attack on the woodpile." Explain.

What are the qualities that make one popular? Can these be cultivated, and if so, how? Each pupil might undertake to acquire at least one quality which he admires in others.

What qualities make for unpopularity? (Bad temper, irritability, selfishness, sulkiness, etc.)

Each student should examine himself in this connection and attempt to eliminate at least one undesirable quality.

(6) We should make good use of leisure time.

"Learn to do something with your hands." What are the possibilities for useful and valuable hobbies of this kind?

What hobby clubs can be organized and fostered in a high school?

(7) We should learn to be good citizens. It is important to read the newspaper, to take an interest in current events, to think about problems of the day. We should appreciate what the community does for its citizens.

Discuss some community problems.

(8) It is important to understand oneself; to judge accurately one's ability to do things; and to analyze the causes of one's failures.

What is a "good sport"? Can one who does not do as the crowd does be considered as "a good sport"?

(9) Life is a quest for happiness. There are certain factors fundamental to happiness in all individuals: good physical health, a measure of success in one's undertakings, confidence in one's ability to do certain things, ability to take criticism, a sense of humor, etc.

List suggestions for making life successful.

How does the forming of good habits ease the strain of life?

What routine health habits help to insure good health?

Discuss the traits that make leaders "popular."

REFERENCE BOOKS FOR MENTAL HYGIENE.

Mental Hygiene of the School Child: Symonds (Macmillan Co.).
Mental Hygiene and Education: Sherman (Longmans).
See also the list of reference books for *Sociology and Psychology* 1.

Problem 2.—How to make the most of personal appearance.

(1) Neatness and cleanliness make for a smart appearance. Clothes should be chosen wisely.

Draw up a scheme for analyzing personal appearance. Discuss the choice of clothing suitable for school, for sport, and for special occasions, such as parties.

(2) Diet, rest, fresh air and cosmetics affect the complexion, and the state of the skin.

What are the common skin diseases, and how can they be prevented?

Discuss the need for caution in the use of cosmetics.

Examine some of the advertisements for cosmetics, noting how the appeal is made.

Why is there so much advertising of cosmetics?

(See *Skin Deep*, by Phillips.)

(3) Good posture give a feeling of well-being and confidence, and makes a favorable impression on others.

Analyze the factors that make for good posture. (The students should examine and criticize their posture.)

(4) Certain health practices have an effect on appearance,—taking sufficient rest, and selecting a proper diet.

What is the function of sleep? What may result from lack of it?

Read the booklet, *Refresh Yourself*, to be had free from the Canadian Tuberculosis Association.

Why should one watch a tendency to overweight?

Discuss common practices in "dieting." Why is "dieting" often harmful? Study advertising material regarding losing and gaining weight.

Make a list of the accepted rules for choosing food, with special reference to vitamins, roughage, and minerals.

(5) The care of one's teeth is important for good appearance.

What causes inflamed and bleeding gums?

How does diet affect the teeth?

Discuss current advertisements of tooth pastes and toothbrushes.

(See *One Hundred Million Guinea Pigs,* by Kallet.)

Problem 3.—How to keep well.

(1) Some diseases are more common to young people especially infectious diseases. As one grows older one's resistance to germ diseases increases.

It is important to be vaccinated and to be inoculated for certain diseases if they are present in a community.

Explain the modern method of vaccination against smallpox. Look up the history of smallpox.

Find out how toxins and antitoxins are made. Why do these build up an immunity in the body?

(2) Diseased tonsils, adenoids or abscessed teeth are often foci of infection for the body.

Discuss the work of the tonsils and adenoids.

What is meant by a focus of infection? What harm can these points of infection do?

(3) Certain simple procedures prevent one from catching diseases from others.

Discuss such health practices as using one's own towel and other toilet articles, washing hands before touching food; keeping up a high resistance, etc.

(4) The common cold often leads to something more serious. It is due to a virus infection which attacks the body when resistance is low.

Discuss how one can catch a cold from oneself; from other people.

What is meant by a virus infection?

What are recommended treatments for colds?

(5) Smoking and "drinking" are practices that may develop into habits injurious to health.

Look up the results of authoritative investigations regarding the effect of alcohol and of tobacco on different physical or mental functions of the body.

Why do athletic coaches rule out tobacco?

Why are Arctic explorers forbidden to use alcohol?

(6) There are many health fads and fallacies prevalent today. Patent preparations of all kinds are used, and many of them are of little value.

People are still superstitious.

Collect advertisements of "health foods," and of remedies and treatments for disease. Discuss the value of these advertised articles.

List some common superstitions. Read *Eat Drink and Be Wary,* by Schlink; or *Devils, Drugs and Doctors,* by Haggard.

Additional References for this Theme:

Hygiene for Students and Teachers: Eastwood (Macmillan Co.).
Man Versus Microbes: Kopeloff (Garden City Publishing Co.).
Devils, Drugs and Doctors: Haggard (Harpers).
One Hundred Million Guinea Pigs: Kallet (Vanguard Press).
Skin Deep: Phillips (Vaguard Press).
Eat, Drink and Be Wary: Schlink (Corvici-Friede).

THEME III.—SOME PRESENT-DAY HEALTH PROBLEMS FOR YOUNG PEOPLE.

Problem 1.—The Social Diseases.

Syphilis.

(1) The origin of the disease is obscure. One theory is that it was introduced into Europe from America by Columbus and his men.

The disease spread through Europe in epidemic proportions during the 16th and 17th centuries. It appeared in a particularly virulent form causing large sores and was known as the great pox.

Discuss venereal diseases in a straight-forward, clear-cut manner, treating them as you would any other infectious disease. The class should realize that syphilis has become a scourge of the world, and that it spreads because of ignorance. A false sense of modesty prevents the spread of information concerning the disease.

(2) Syphilis is a great menace to young people. In Canada 44,765 people were treated in clinics during 1935 for venereal diseases, and it is estimated that in this year there were more than 30,000 cases of syphilis. In the United States 600,000 newly infected people receive treatment each year. The disease is becoming rare in the Scandinavian countries because of education and compulsory treatment. Treatment is compulsory in Canada except in the provinces of Quebec and Alberta.

(3) The cause of the disease is a corkscrew-shaped organism known as the **spirochaeta pallida.**

The disease is obtained chiefly through contact with infected persons.

Allow the class to read accurate and reliable articles about syphilis. Suggested readings are the following:

Syphilis, in Hygeia for March, 1937.

The Scourge of the World, in *Maclean's Magazine* for October 15th, 1937.

Health League of Canada, Toronto, Ontario.

(4) The disease is not, in a strict sense, inherited; but it may be passed to an unborn child through the blood of the mother. Syphilis has definite symptoms that fall into three stages. It can be discovered by an accurate blood test known as the Wassermann Test.

The treatment, an arsenic compound, was discovered by a German scientist, Paul Ehrlich, in 1912 after twenty years of work.

Every adult should be aware of the disease, means of contracting it and the terrible tragedies it creates in crippling the physical and mental health of an individual.

> Read the story of *Ehrlich's* experiments in *The Microbe Hunters,* by De Kruif.

Gonorrhoea.

(1) This is an infectious disease caused by the gonococcus, a spherical-shaped organism. It was isolated by a German bacteriologist, Neisser, in 1879.

It can be transmitted by contact and by means of towels, bedding and toilet seats.

> Discuss types of bacteria. Show that the gonococcus is an organism similar in shape to the penumococcus (causing pneumonia) and the streptococcus (causing scarlet fever).
>
> Explain methods used to isolate specific germs. (See life of Koch.)
>
> Explain precautions to be taken to prevent infection; as avoiding public towels, covering toilet seats in public places.

(2) Gonorrhoea causes a marked inflammation of the genito-urinary tract, which frequently causes permanent damage. It is one of the most important causes of blindness in infants. The disease can be treated and cured and every effort should be made to prevent its spread.

> Emphasize the importance of consulting a doctor about unusual symptoms so that prompt treatment may be started.

References for this Problem.

The Microbe Hunters: De Kruif (Harcourt Brace).
Devils, Drugs and Doctors: Haggard (Harper Brothers).
Man versus Microbes: Kopeloff (Garden City Publishing Co.).

Problem 2.—Alcoholism as a social and economic problem.

(1) "Alcohol and gasoline don't mix". The law imposes severe penalties on persons who attempt to operate motor vehicles when under the influence of alcohol.

(2) Organized society has to contend with poverty, child neglect, crime, insanity, broken homes, disease, misery and inefficiency.

Make an investigation to discover how the use of alcohol is related to these problems.

Review, in this connection, Problem 1 of Theme 2; and consider what effect a general improvement of the economic and social environment might have on the problem of alcoholism.

Discuss government control of the liquor business.

THEME IV.—HEALTH IN EMERGENCIES.

This theme is planned for a school where boys and girls can be taught separately. Home Nursing is to be given to the girls, and First Aid to the boys. If, however, it is impossible to divide the class, First Aid may be taken with both boys and girls.

A.—Home Nursing.

This unit is planned to give only very simple instruction in the care of the sick. Very little equipment is needed and the cost of such equipment should be only a few dollars.

(1) Health and the home: (a) choosing the sickroom; (b) furnishing, arranging, cleaning and caring for the sickroom;

(c) keeping the home clean—special care of the kitchen and bathroom; (d) care of laundry in the home; (e) care of garbage and waste material.

Discuss such points as how to make a sickroom attractive, how to get good ventilation, elimination of unnecessary furniture, choosing the bed and bedding, etc.

(2) The home nurse: (a) duties of a home nurse; (b) dress and personality of the home nurse; (c) good management in the sickroom; (d) how to protect oneself against infections and keep well.

(3) Daily routine in the sickroom: (a) morning care—how to give a cleansing bed bath; how to make and change the bed; care of the teeth and hair; (b) how to prepare a patient for meals; (c) how to get a patient up in a chair; (d) how to prepare a patient for the night.

By demonstrations with a large doll show how to give a bed bath. With a large doll's bed or on a Winnipeg couch show how to make a bed when empty and also with a patient in it.

(4) Indications of sickness: (a) common symptoms of illness as sore throat, headache, vomiting, pallor, pain, and the significance of these; (b) temperature, pulse and respiration; (c) inflammations.

Discuss symptoms of a few common diseases as measles, mumps, appendicitis, etc.

Teach the class how to read a thermometer, how to take pulse and respirations. Discuss why these change with illness. What causes inflammation? What are the signs of inflammation?

(5) Care of patients with communicable diseases: (a) care of bed linen, towels, dishes, etc. to prevent spread of infection in the house; (b) how the nurse should protect herself from taking the disease; (c) complications of some of the common communicable diseases; (d) how to clean and disinfect a room.

Discuss ways in which disease germs are transmitted.

Discuss common methods of disinfection as heat, sunshine, soap and water, chemical disinfectants.

Explain why fumigation has proven valueless.

(6) Feeding the sick: (a) how to set a tray; (b) choice of foods—kinds of diets, as liquid, soft and light, and when they are indicated; (c) how to feed a patient in bed.

Give a demonstration on how to set a tray.

Discuss diets for various types of illnesses, as a common cold, measles, anaemia, a broken leg, etc.

(7) How to prepare and give simple treatments: (a) a mustard plaster; (b) a linseed poultice; (c) hot and cold compresses; (d) testing and filling a hot-water bottle; (e) how to give medicines.

Give demonstrations in teaching these if possible.

(8) Care of special injuries or ailments, as vomiting, earache, sties, sleeplessness, nosebleed, wounds, stings, hiccough, sunstroke, etc.

Discuss how to improvise and make such things as a backrest, a bed-table, a tray, a cradle, sterile dressings, etc.

Reference:

American Red Cross Textbook on Home Hygiene and Care of the Sick, published by P. Blakiston's Son and Co., Philadelphia.

B.—First Aid.

(1) One in twenty of all deaths in Canada in 1935 were caused by accidents. It is estimated that about one-third of accidents happen in the home, one-third on streets and highways and the rest in factories, in industry, and in sports.

Obtain figures on accidental deaths from the Dominion Provincial Bureau of Statistics and from insurance companies. Discuss means of eliminating accidents in the home and on streets and highways.

(2) Accidents on streets and highways: (a) how such accidents happen; (b) principles of treatment; (c) what to do for fractures; (d) how to treat deep cuts and severe bleeding;

(e) how to apply dressings; (f) how to lift and carry a patient and when not to move him.

Collect newspaper clippings on accidents and discuss the cause, possible injuries and what should be done. Show how to apply splints, how to treat fractures when splints are not feasible; how to apply a tourniquet and pressure bandages to check bleeding, etc.

(3) Accidents in the home: (a) reasons for so many home accidents; (b) treatment for such accidents as—(i) dislocations and sprains, (ii) burns and scalds, (iii) electric shock and suffocation with gas, (iv) poisoning, (v) choking, swallowing a pin.

Discuss newspaper accounts of home accidents.

Analyze fire dangers in a home.

Discuss ways of improving housekeeping to prevent accidents.

Show by demonstrations how to give first aid for common types of home accidents.

(4) Accidents in sports: (a) swimming and boating; (b) skating, skiing and sleighing; (c) games such as football; (d) gunshot wounds.

Discuss precautions to take to prevent accidents in sports. Analyze these activities to determine what are likely to be the common accidents. Give demonstrations of how to do artificial respirations, etc.

(5) Accidents and emergencies at school: (a) nose bleed; (b) fainting; (c) cuts, wounds, scratches; (d) burns, particularly from acids and chemicals.

(6) Materials that should be on hand at home and at school to meet emergencies. Plan and equip a first aid kit for school use.

References:

Accident Prevention and Elementary First Aid: Red Cross Calgary. First Aid to the Injured: St. John Ambulance Association.

B. Physical Education (1).

Unit I: The basis of the course is **Fundamental Gymnastics, which is compulsory**, and should receive approximately **one-half** of the time for the period or the week.

Unit II: Selected activities of the following types:

For girls: tumbling, light apparatus work, vauting; dancing—folk, natural, tap, ball-room; games for the entire class.

For boys: tumbling, apparatus, pyramid-building; mass-boxing; training for track and field athletics; games for entire class.

In addition to the above-mentioned class activities, the following are to be regarded as forming parts of the syllabus; instructors will be required to devise their own methods of directing and evaluating:

(a) Out-of-school participation and improvement of performance in at least one summer sport and one winter sport.

(b) Development, progress and improvement in posture and carriage; in strength, health and muscular co-ordination; in healthful habits; and in good sportsmanship as displayed in attitudes toward team-mates, authority, rules of the game, and weaker players.

(c) Individual corrective exercises for students for whom such are prescribed by the medical examiner.

Teachers should encourage students to form clubs for promoting different types of outdoor recreation; such as, skiing, badminton, tennis, skating, hiking, golf and mountain climbing. Physical Education aims to promote health both through **training** and through **recreation.**

Fundamental Gymnastics.

The instructor is to build up a series of exercises from those described in *Recreation and Physical Fitness for Youths and Men* and *Recreation and Physical Fitness for Girls and Women,* choosing tables 1 to 8 for boys from the first volume, and tables 1 to 12 for girls from the companion volume.

The series of exercises should include all the "muscle-groups" in various combinations; and it is suggested that the instructor be guided by the procedure described in the books named. Care must be taken to have progression in each series in order to avoid muscular strain and fatigue, and also to achieve improvement in carriage, strength, flexibility and agility. The series should start with exercises of an introductory or "warming-up" nature; such as marching, toe marching, running, skipping, sliding, leaping, hopping, and the class should finish in position in open order, ready for the remaining exercises.

The exercises should be done in a continuous rhythmical manner; while one exercise is being done the next exercise is mentioned, the cautionary word "ready" is given, and then the executive word "change", without a break in the rhythm; e.g., "Skip jumping on the spot, Ready, Begin . . . . Head dropping forward and stretching upward . . . . Ready . . . . Change . . . ."

For the "routine" the instructor should choose one exercise or more from each of the following groups:

1. Head and Trunk.
2. Arm and Shoulder.
3. Leg and Balance.
4. Trunk Lateral.
5. General Activity, including group games and voluntary practices.

The class should work on one set of exercises until a smooth, rhythmical routine has been learned. At this stage, new exercises may be introduced, not more than one in each lesson, and incorporated into the routine. After such a series has been learned, the teacher should place a good performer in front of the class, to give the time and rhythm for the class to follow, releasing the instructor to move about and give quiet instructions and corrections to individuals.

It is not intended that any "table" of the text be followed in detail but that these be used as the sources of the exercises which the instructor uses for his series.

Tumbling, Vaulting, Pyramid Building.

Equipment for a class of from 30 to 40 members: 4 to 6 benches, vaulting horse, vaulting box, 4 to 6 mats, spring-board.

Dress: shirt or jersey, shorts (or slacks), running shoes.

Use of equipment: Training in quick and careful handling of apparatus is essential. The forms, horse, etc., must not be dragged along the floor. The box, when used, should be carried in several sections. The apparatus must be so arranged that it can be brought out and cleared away without waste of time. Care must be taken to ensure that it is firmly fixed and will not slide. When forms are used one on the other, they must be supported.

The class should be divided into activity groups, each under the supervision of a capable leader, and no group should be confined to one type of activity throughout the period. The instructor must be sure that the leaders are responsible and trained in methods of support to eliminate danger of accidents. The reference books outline the procedures which ensure progression from elementary to more advanced work.

At the end of the year each student should be able to perform the following "tumbling stunts" in good form:

Forward roll, backward roll, cartwheel, headstand, elbow stand, handstand and support; and also the following: Crouch vault over box-horse, jump to crouch and catspring off, fence vault, leapfrog over horse, through vault.

The instructor should read carefully the section on vaulting in the text, noting particularly the methods of receiving and assisting.

Pyramid Building.

This is valuable in developing precision and teamwork. Students should start from a base line and return to it. The pyramids should be built in successive steps, the students performing to numbers and building from centre to flanks. The instructor should begin with elementary pyramids, using groups of two, three or four before attempting large group pyramids. Strict discipline must be observed, particularly when breaking the pyramid, to prevent accidents. It should be noted that this activity is better suited to boys than to girls, unless the latter are restricted to the use of the simpler sets in which the individuals are not subjected to supporting the weights of others. Unusual strains must be avoided.

Dancing (Girls' Classes).

A pianist is necessary, and the class should be limited to 35. It is suggested that two of the following groups be selected, but instructors should feel free to vary this arrangement in accordance with their own training and the previous training of their students; instructors should also note the interesting exercises with balls and skipping ropes on pages 57-71 of *Recreation and Physical Fitness for Girls and Women,* which may be used as alternative to dances if preferred.

(a) Folk and group dances suitable for adults:

Oxen dance
Maypole
Swedish spinning
Virginia reel
Swedish weaving
Daldans
Spanish tarentella
Waltz quadrille
Various schottisches and mazurkas

(b) Tap dances which should include the following: Waltz routines, soft-shoe routines, jigs, military routines, buck routines.

(c) Ball-room dancing: waltz, hesitation steps, fox-trot, cross-chasse, cross-open; polka, minuet, mazurka, Sir Roger de Coverley.

(d) Interpretive and ballet dancing (to be attempted only by teachers having special training).

Teachers' References for Physical Education

Recreation and Physical Fitness for Girls and Women (Board of Education, London).

Recreation and Physical Fitness for Youths and Men (Board of Education, London).

The two books named above are to be considered as basic to the courses in Physical Education 1 and 2.

Niels Bukh: *Fundamental Gymnastics* (E. P. Dutton & Co.).

This book is for the use of teachers who have had training in the Danish system.

Bartlett: *Junior Athletics* (Clarke, Irwin & Co.).

This is suited primarily to the intermediate grades, but contains sections on games and pyramids suitable for Grade X.

Cotteral: *Tumbling, Pyramid Building and Stunts for Girls and Women.*

This book is suitable for girls' classe, Grades X and XI.

Williams: *Principles of Physical Education.*

References for Dancing:

Hinman: *Gymnastic and Folk Dancing* (A. S. Barnes & Co., New York).

Ballwebber: *Illustrated Tap Rhythms and Routines* (Clayton F. Summy Co., New York).

Ballwebber: *The Clog Dance Book* (Clayton F. Summy Co., New York).

Frost: *Clog and Character Dances* (A. S. Barnes & Co.).

Hinman: *Taps, Clogs and Jigs* (A. S. Barnes & Co.).

Ford: *Quadrilles* (Dearborn Publishing Co., Dearborn, Mich.).

Manning: *Tap Routines* (Jack Manning Dance Studio, New York).

Burchenal: *Dances of the People* (A. S. Barnes & Co.).

PHYSICAL EDUCATION 2.

Physical Education 2 is a general elective for the second year of the High School Programme (Grade XI). The course is a continuation of the work prescribed for Physical Education 1, but students and teachers are asked to note that **the course may be given only in schools where the following requirements can be met:**

1. Regular use, for two periods per week throughout the year, of a gymnasium equipped with piano, mats and other suitable equipment.

2. Separate instructors for boys' and girls' classes.

3. Time-table provision separate from that for Physical Education 1.

4. Instructors possessing some special training and ability in Physical Education.

The reference books listed under Physical Education 1 are those also recommended for this course. Methods of conducting classes, and the important place to be given to Fundamental Gymnastics as are also described for the former course.

Outline of Course.

Unit I: Fundamental Gymnastics. Selected exercises from Table 9 and following tables (boys) and from Table 13 and following (girls).

Unit II: Selected activities as under Unit II of the former course.

Unit III: Out-of school participation and reasonable proficiency in out-door sports suitable for each season.

Unit IV: Improvement in posture, carriage, health, strength, muscular co-ordination, healthful habits, attitudes of good sportsmanship.

Unit V: As an alternative for Unit II, or portions thereof, in schools in which the instructor possesses unusual experience and training in such sports, a course in coaching **one or two** of the following:

(For girls): Basketball, softball, tennis, track and field athletics (racing, hurdling, relay, jumping, throwing).

(For boys): Soccer, rugby, baseball, hockey, basketball, track and field.

N.B.—The coaching course must not be allowed to consume more than one-half the time of the entire course. Fundamental Gymnastics is to be given its place. The purpose of this unit should be to train leaders capable of playing, coaching, refereeing and of training and managing teams. Instruction should be given on the floor, rink, or playing field, and should include instruction in the following:

Rules of the game.
How to play each position.
Selection of players.
Basic team-plays.
Also, practice in refereeing, coaching and managing teams.

Further Reference Books for Teachers

Modern Philosophy of Physical Education: Wayman.
Teaching Principles of Health Education: Conrad & Meister.

SCIENCE

BIOLOGY

The two courses in Biology do not form a sequence. Biology 1 is a General Elective, designed to help the student understand some of the problems in Biology that are most likely to be met in everyday life. The course is informational rather than technical. It is **not** a prerequisite for Biology 2. Biology 2 is an Academic Elective of the Third Year, intended for students who have a special interest in science, and who are preparing for university matriculation into a faculty in which they may specialize in science.

BIOLOGY 1.

The course in Biology 1 comprises the following:

(i) An intensive study of Units I, II, III and IV of the prescribed textbook, including practical and experimental work.

(ii) A general survey of any two of the following units of the prescribed textbook: Units V, VI, VII and VIII. Units VII and VIII present material of particular interest to rural students. In fact, a considerable part of the course is based on material that was formerly to be found in textbooks on Agriculture.

Some work should be done in identifying and classifying the plants of the school community. For this purpose the use of a botanical "key" will be necessary. Some time should also be given to the study of insects and of bird life in the school community.

The textbook is to be supplemented by material to be obtained from bulletins published by the Dominion or the Provincial Department of Agricuture, or from any other available publications relating to Agriculture.

The Publicity and Extension Branch of the Dominion Department of Agriculture, Ottawa, publishes a Departmental Directory and List of Publications, including regulations, reports, bulletins, pamphlets, circulars, charts and folders, and lantern slides. Teachers who desire information regarding the literature and other material that is available should send for this Departmental Directory and List of Publications.

In the same way, teachers who desire information regarding the literature and other publications available from the Provincial Department of Agriculture are asked to direct their inquiries to the **Agricultural Extension Service, Department of Agriculture, Edmonton.**

It is not the intention of either of these departments to furnish material for use of individual students. All requests for literature and other material should be sent by the teacher and the material so obtained should be placed in the school library.

N. B.—The course in Biology 1 should be correlated with the course in Health Education. Physical Education in the high school is not merely a matter of health habits. It is concerned also with building a scientific foundation for health habits. Units I, II, III, IV and VIII are important for this purpose.

The prescribed textbook for this course is the following: Pieper, Beauchamp and Frank: *Everyday Problems in Biology,* Canadian edition (W. J. Gage & Co.).

REFERENCE BOOKS FOR THE USE OF THE TEACHER

Teachers' Guide to *Everyday Problems in Biology* (Scott Foresman).

Wood and Carpenter: *Our Environment—The Living Things In It* (Allyn and Bacon).

Benedict, Knox and Stone: *High School Biology* (Macmillan).

Kroeber and Wolff: *Adventures With Living Things* (D. C. Heath & Co.).

Curtis, Caldwell and Sherman: *Biology for Today* (Ginn & Co.).

Hunter: *Problems in Biology* (American Book Co.).

Sir J. Arthur Thomson: *Biology for Everyman,* 2 Volumes (Dent & Sons).

Wheat and Fitzpatrick: *General Biology* (American Book Co.).

Bush, Dickie and Runkle: *A Biology of Familiar Things* (American Book Co.).

Barrows: *Elements of General Biology* (Farrar & Rhinehart).

Smallwood, Reveley and Bailey: *New Biology* (Allyn and Bacon).

Canadian Agriculture for High Schools (Macmillan).

Hegler: *Progress of the Animal Kingdom* (Macmillan).

Woodruff: Foundations of Biology (Macmillan).

Moon and Mann: *Biology for Beginners* (Clarke Irwin).

Sir J. Arthur Thomson: *Outlines of Zoology* (Clarke Irwin).

MacKinnon: *The Animal's World* (Clarke, Irwin Co.).

Spotton, Cosens and Ivey: *Wild Plants of Canada* (W. J. Gage & Co.).

Hales: *Select Western Flora* (Macmillan Co.).

Lutz: *Field Book in Entomology* (Thomas Allen).

Taverner: *The Birds of Canada* (Musson Book Co.).

> This informative and authoritative book deals with all kinds of birds known to occur in Canada. Originally prepared for the National Museum of Canada, the book contains 173 coloured plates and also 500 figure drawings.

Taverner: *Canadian Land Birds*—a pocket field guide (Musson Co.).

Taverner: *Canadian Water Birds*—a pocket field guide (Musson Co.).

BIOLOGY 2.

The course in Biology 2 is designed to prepare students for further training in Biology by furnishing them with the background necessary for understanding the basic principles of Biology. The course will comprise the material set forth in the authorized textbook.

The course is not, however, merely a reading or informational course, but will require the completion of the suggested activities which are described at the end of each chapter.

Laboratory Work.

Laboratory work, assigned both to individual students and to small groups of students, is a very important part of the course. At least **two** periods per week must be reserved for this work. In all classrooms where Biology is taught, a good microscope will be required, such as will magnify to 300 or 400 diameters, and can be obtained at a price of about $40.00. There should also be available magnifying glasses for the students' use, and dissecting instruments. Supplies can be obtained from the local school supply houses.

Each student is required to keep a record book showing the laboratory work which he has performed during the year, with descriptive drawings, explanations and a statement of results. The teacher will grade this work and certify its performance.

TEXTBOOK: Fitzpatrick and Horton: *Biology* (Houghton Mifflin Co.).

There is a **Teachers' Manual** to accompany the textbook.

Reference Books for the Teacher: See the list of reference books for Biology 1.

CHEMISTRY

CHEMISTRY 1.

This course is as outlined in the textbook. Laboratory demonstration and practical work is required.

TEXTBOOK:—Black and Conant: *New Practical Chemistry* (Macmillan Company). Chapter 14 is optional. Chapter 22 is to be omitted.

FOR REFERENCE:—*Teachers' Manual for Practical Chemistry,* by the same authors, may be obtained from the School-Book Branch.

New Laboratory Experiments in Practical Chemistry: Black (Macmillan Company).

N.B.—For Reference Books, see the list below under Chemistry 2.

CHEMISTRY 2.

This unit should be offered only in those schools where the instructor in Chemistry holds, at least, standing in Chemistry 2, or its equivalent, and where the laboratory equipment is adequate for performing all of the prescribed experiments.

The Introduction, Complex Silicates, pages 97-101, Chapter XII, Chromium, pages 234-236, Chapters XXII, XXIV, XXVI, and the Conclusion of the authorized text-book may be treated as required reading, and need not necessarily be dealt with in class.

The following exercises from the Manual comprise the practical work of the year:

(a) To be treated as demonstration experiments only: Exercises 14, 19 (No. 5 only), and 42.
(b) To be treated either as demonstration experiments or to be required of all pupils, as the teacher may determine: Exercises 6, 27, and 39.
(c) To be required of all pupils: Exercises 8, 9, 10, 13, 15, 16, 17, 21, 22, 25, 32 (Experiment 1 only), 33, 34, 35, 36, 37, 38, 40, 41, 43, 46, 50, 51, and 52.

It is felt that the above prescription should require roughly 30 periods in the laboratory, allowing two periods for Exercise 33, and four or five for Exercises 51 and 52. This does not include the time required for demonstrations by the teacher.

Each teacher of Chemistry 2 will be required to certify before June 30th, 1939, that his students have performed the laboratory experiments outlined in the authorized Manual.

In the examination in Chemistry 2, 85 per cent. of the marks will be based on the written examination; the other 15 per cent., on the laboratory work of the student. In submitting their certified statements, teachers will be required to give their estimate of the practical work of each student, by assigning him a mark from the total allotted for this part of the course. This mark will be added to that received by the student in his written examination.

For the purposes of the laboratory work, experiments performed in groups of two will be considered as individual work.

Teachers of Chemistry 2 are requested to note that the laboratory work of candidates should be graded. Only in those cases where all experiments have been performed and recorded with as great perfection as can be expected from a Grade XII student should the maximum be allowed. Candidates will be required to secure pass standing on the Laboratory work as well as on the examination in Theory.

Physics 2.

TEXTBOOKS:—

Littler: *Elementary Chemistry*, Book II.
Littler: *Laboratory Manual* to accompany Book II.

Reference Books for the teacher.

Harms and Hausrath: *Consumer Science* (Macmillan Co.).

McPherson, Henderson and Fowler: *Chemistry at Work* (Ginn & Co.).

Braur: *Chemistry and Its Wonders* (American Book Co.).

Kruh, Carleton and Carpenter: *Modern Life Chemistry* (Lippincott & Co.).

Dull: *Modern Chemistry* (Henry Holt & Co.).

GENERAL SCIENCE

INTRODUCTION.

Today we are concerned with changing the teaching of Science so as to make it contribute more effectively to general education. It is expected that those students who intend to specialize in Science or proceed to university levels, will take the courses outlined in the High School Programe as Physics, Chemistry, Geology, and Biology. These courses in General Science are concerned with the education of a much larger number of young people who will make up the majority of the coming generation of adults. The schools today are attempting to give to these young people preparing for active participation in modern society "a much wider knowledge of the world in which they are living and of its history than the traditional curriculum affords them." To this end educators have devised a system of general education.

Under such a system, the content and methods of teaching are chosen because of their **significance for human living.** Every one of these students will become a consumer of commodities; hence consumer science is given a prominent place in these courses. Our energy resources, their utilization and conservation, are of vital importance to all of us and are treated as social problems. Metabolism and growth, sense organs and the nervous system are studies that enable man better to understand his own physical being. The improvement of plants and animals by scientific breeding is a valuable study.

These courses cut across the traditional subject-matter fields of the physical and biological sciences, and are exploratory to the degree that they offer guidance in these fields. As such, an understanding of the scope of each field is necessary.

(Classification and scope from *Man's Physical Universe,* Macmillan Co.):

1. The Physical Sciences.
    - (a) Astronomy—the science of the universe outside of our own planet.
    - (b) Physics—the science of matter in motion.
    - (c) Chemistry—the science of the composition of matter.
    - (d) Mineralogy—the science of minerals.
    - (e) Geology—the study of the structure of the earth.
2. The Biological Sciences.
    - (a) Botany—that portion of Biology which relates to plants.
    - (b) Zoology—that portion of Biology which relates to animals.

(c) Paleontology—the science of extinct forms of life.

(d) Bacteriology—that portion of Biology which relates to bacteria.

(e) Physiology and Hygiene—the science of the functions of living organisms and of preserving health.

In these courses in General Science for general education, descriptive science is very important. In consumer science, the student is given careful training in observation, and must learn to detect identifying factors in various finished products. The objective to be obtained is that of consumer knowledge and protection in an industrial system that is ever increasing in complexity.

The laboratory should be a place where the pupil can pursue truth in the manner of the scientist. In science courses, experimental work has been emphasized because of its relation to the "scientific method"; also because it provides pupil activity. In general education, the scientist accepts proven laws without verification and expends his energy on uses he can make of such generalizations. Laboratory experiments are useless unless performed with a purpose in view and definite outcomes in mind. The experiment must function in the life of the pupil. Such work should embody the spirit of problem-solving as a teaching method. Evidence should be gathered and observations should be recorded faithfully. The laboratory should be a place where pupils can find answers to questions and not merely verify textbook descriptions. A unit on laboratory techniques is provided to enable the student to perform essential experiments with ease and with thought for economy of time and materials and for the safety of health and life.

Finally, pupils should learn to recognize the ways in which science enters into human affairs, and the contribution it has made to our civilization. The scientific method, once mastered, gives one a way of thinking that can be applied in all walks of life. Pupils from their study should be able to formulate a large number of generalized insights.

NOTE:—Each course is arranged as a number of problems. **Every student must take the problems that are marked with an asterisk.** To complete the course, the student may choose among several problems those that may have greater appeal. An attempt is made to take care of the science requirements and interests of girls as well as boys. Since such courses as these should be exploratory, an attempt is made to provide guidance for the student by sampling the content of the different sciences. To avoid monotony, it is suggested that the units on measurement and on laboratory techniques be spread over the school year.

REFERENCE BOOKS

Throughout the problems in both courses, the following books will be required as references, and will be designated by the Roman numerals that appear in front of the title. An additional list of suitable reference books is included, but these books are not designated by Roman numerals.

I. *Elementary Science* by Allen and Ferguson—The Ryerson Press, 1934.

II. *Consumer Science* by Harms and Hausrath—The Macmillan Co., 1939.

III. *Consumer Goods* by Reich and Siegler—American Book Co. (W. J. Gage & Co. in Canada), 1937.

IV. *Senior Science* by Bush-Ptacek-Kovats—American Book Co. (W. J. Gage & Co. in Canada), 1937.

V. *Understanding the Universe* by Carroll-Rexford-Weed—The John C. Winston Co., 1939.

VI. *Physics of Today* by Clark-Gorton-Sears—Houghton Mifflin Co., 1938.

VII. *Chemistry at Work* by McPherson-Henderson-Fowler—Ginn & Co., 1938.

VIII. *Adventures With Living Things* by Kroeber and Wolff—D. C. Health and Company (The Copp Clark Co. in Canada), 1938.

IX. *The Science of Everday Life* by Van Buskirk and Smith—Houghton Mifflin Co., 1936.

Man's Physical Universe by Arthur T. Bawden—The Macmillan Co., 1937.

Chemistry and Its Wonders by Oscar L. Braur—American Book Co. (W. J. Gage & Co. in Canada), 1938.

Elementary Practical Physics by Black and Davis—The Macmillan Co., 1938.

Science In Daily Life by Trafton and Smith—J. B. Lippincott Co., 1936.

Modern Life Chemistry by Kruh, Carleton and Carpenter—Lippincott Co.

Modern Chemistry by C. E. Dull—Henry Holt & Co.

Our Physical World by Eckels, Shaver and Howard—Sanborn Co.

New Elementary Physics by Millikan, Gale and Coyle—Ginn & Co.

Science in General Education by the Commission on the Secondary School Curriculum under the direction of the Progressive Education Association. The Appleton-Century Co.

N.B.—See also the list of reference books under "Physics 2" on pages 69 and 70 of this Bulletin.

GENERAL SCIENCE 1.

Subject Matter	Reference	Section or Pages
***Problem 1. (Simple Survey).**		
What are the chief conditions of the environment?		
This problem is a brief review of the following conditions studied in detail in Grades VII and VIII—light, air, temperature, water, the earth's surface, gravity, altitude.	I.	Chap. V.
	I.	P. 253-259.
	II.	II—The Nature of Things.
	V.	P. 1-15.
	VIII.	P. 773, 780, 783, 786, 797.
	IX.	P. 592, 599, 283-293, 103-109, 313, 366.
***Problem 2.**		
How does man obtain a knowledge of his environment?		
1. The sense organs.	IV.	See Index-eye.
(a) Sense of feeling—nerve endings in the skin.	V.	P. 241-242.
(b) Sense of hearing—structure of ear.		See Index-eye.
(c) Sense of balance—the three semi-circular canals.	VI.	P. 432, 350.
	VIII.	P. 373-378.
(d) Sense of taste—taste pores or buds and their location—the four kinds of taste sensations, sweet, sour, bitter, salty.	IX.	P. 355-357, 34, 405.
(e) Sense of smell—special areas in the upper nose passage.		
(f) Sense of sight—structure of the eye.		
2. The nervous system (an elementary study).		
(a) Structure of a complex cell (neuron).		
(b) Afferent and efferent neurons.	V.	P. 518-521, 578.
(c) Nerve centers.	VIII.	P. 370-405, 557, 561.
(d) A reflex act (reflex arc).		
(e) A brief study of instinctive behaviour (a series of reflexes—web spinning of a spider).	IX.	P. 590.
(f) A conditioned reflex.		
(g) Trial and error learning.		
(h) Learning by association.		
Note: Man has learned to speak and write. Because of these tools he can learn from others what it took them days or months or years to learn. He can draw on their experiences to help him reason.		
***Problem 3.**		
What is the scientific method?		
1. There are five well defined steps:	II.	III—Solving Science Problems.
(a) Gathering facts to be explained.		
(b) Classification of these facts.	III.	P. 3-11.
(c) Formulation of a theory to explain the facts.	VIII.	P. 1-6.

Subject Matter	Reference	Section or Pages
(d) Experimentation.	IX.	Intro. V-XVII.
(e) Formulation of law.		P. 1-6, 615-616.
2. Stages in the growth of science:		
(a) The anecdotal stage.		
(b) Combating superstition.		
(c) Simplification and popular expression (law).		
(d) Prediction and control.		
3. Some great discoveries in science were:		
(a) That the earth is round; (b) that the sun is the center of our solar system; (c) that gravitation is universal; (d) that stars are suns and centres of other solar systems; (e) that matter is composed of atoms; (f) that the earth is very old; (g) anesthetics to banish pain; (h) evolution in plants and animals; (i) that micro-organisms cause putrefaction and disease.	I. V. VI. VII. VIII. IX.	P. 39-85. P. 646-695. P. 1-21. P. 225, 433-434. P. 121-128, 491-492, 507, 510, 523-534. P. 293-310, 603-607.
4. Some great inventions in science were:		
(a) the use of crude implements of wood and stone; (b) the use of fire; (c) the invention of the bow and arrow; (d) the invention of pottery; (e) the domestication of animals and the cultivation of plants; (f) irrigation; (g) the primitive wheel and boat; (h) the smelting of iron ore; (i) the art of writing; (j) the invention of paper; (k) the printing press; (l) the mariner's compass; (m) gunpowder; (n) steam engine, steamboat, and locomotive; (o) spinning and weaving machinery; (p) the invention of the electro-magnet, telegraph, telephone, dynamo, wireless transmission; (q) flying machines.	II. III. IV. IX.	Unit II. Unit XVII. P. 77-79. P. 540-575, 607-614.
***Problem 4.**		
How does the scientist measure?		
1. Importance of measurement in everyday life.	V.	P. 131-136.
2. The history of measurement.	VI.	P. 9-11.
3. The metric system.		
4. Measurement of (a) a straight line; (b) area; (c) volume.		
5. How to use a graduated cylinder.		
6. Various methods for determining the volume of objects.		
7. The measurement of mass.		
8. Find the density of (a) a rectangular solid; (b) water; (c) mercury; (d) other substances.		
9. Show the effect of expansion and contraction on the density of water.		
10. Table of densities.		
11. To find the specific gravity of various substances.		

Subject Matter	Reference	Section or Pages

12. The measurement of temperature.
13. The meaning of significant figures in measurement.

***Problem 5.**

What practices does the scientist employ in his workshop to secure a more efficient and safer use of materials and a saving in time and effort?

Reasons for these practices:

1. Safety of the experimenter.
2. Safety of others in the laboratory.
3. Neatness and cleanliness.
4. Saving of materials (chemicals).
5. Saving of apparatus.
6. Saving of time.
7. More efficient operation of apparatus.

Experiments to demonstrate these practices:

1. Wet filter paper before filtering.
2. Light the match before turning on the gas.
3. Pour powders or crystals on folded paper instead of directly into test tubes.
4. Stand all funnels mouth downward on the desk.
5. Place wire gauze beneath glassware that is to be heated.
6. Move the flame when heating glassware until the glassware becomes hot.
7. Always flush the sink with water after throwing away acid.
8. Wet glass tubing before forcing it through a rubber stopper.
9. Smell gases by fanning a small amount of the gas towards the nose.
10. Wash all glassware immediately after using.
11. Replace stoppers of reagent bottles immediately.
12. Flood clothing or skin with water and follow with baking soda when acid is accidently spilled.
13. Never support apparatus on boxes, match boxes, etc.
14. Put all used solids in waste jars.
15. Be sure glass vessels are dry on the outside before heating.
16. How to treat burns.
17. Dangers that are present in (a) filling an alcohol lamp, (b) handling phosphorus, sodium or potassium, (c) handling various acids.
18. When dealing with explosive reactions (burning hydrogen at a jet) wrap a wet towel about the apparatus.

Note: These are typical of other practices to be introduced at the discretion of the teacher.

Subject Matter	Reference	Section or Pages
***Problem 6.**		
How does the scientist set up apparatus for an experiment?		
1. Names of ordinary vessels, tubes, stoppers, etc.		
2. Bend glass tubing to make a smooth, rounded right-angled bend.		
3. Draw glass tubing (a) to close or seal an opening, (b) to make a jet.		
4. Cut glass tubing (a) with a file, (b) with heat.		
5. Fit a cork to an opening.		
6. Insert glass tubing in the opening of a cork or rubber stopper.		
7. Bore a hole of required size in a cork.		
8. The difference in composition and use of different kinds of glass (pyrex, etc.).		
9. Supports for beakers, Florence flasks, tubes, etc., when arranging an experiment.		
10. Seal apparatus with wax as for hydrogen preparation when the gas is to be burned at a jet.		
11. Arrange apparatus to transfer air (a gas) from one vessel to another.		
12. Arrange a liquid trap in a gas line.		
13. Blow a glass bulb as for a thermometer tube.		
14. Fire-glaze a surface.		
15. Filter a liquid.		
Note: These are typical of other practices to be introduced at the discretion of the teacher.		
***Problem 7.**		
How can we distinguish matter, mass, and weight?		
1. Definition of each term.	I.	P. 269.
2. The properties of matter:	V.	P. 95-111.
(a) The one property which does not change—inertia (i) of bodies at rest, (ii) of bodies in motion.	VI.	P. 3, 6, 8, 9, 11, 14, 15, 17, 19, 20, 60, 170, 268.
(b) The molecular theory of matter.	VII.	P. 4-5.
(c) The difference between molecule and atom—definition of an element in terms of the atom.	IX.	P. 9, 430, 433.
(d) The three states of matter—solid, liquid, and gas—explained in terms of molecules and their motion.		
(e) Molecular forces—cohesion, adhesion.		
(f) Elasticity—explanation and applications.		
(g) Tenacity—explanation and applications.		
(h) Ductility—explanation and applications.		
(i) Malleability—explanation and applications.		
3. The weight of a body is the attraction of the earth for that body. (Weight is a force).		

Subject Matter	Reference	Section or Pages
(a) Variation in weight (i) at sea level, (ii) on a mountain top, (iii) at the equator, (iv) at the poles.	VI.	P. 110, 171-173.
(b) The standard weight of a body is its weight at 45 degrees latitude at sea level.		
(c) How weight is measured—various types of scales—the spring balance.		
(d) Nature of a force—You cannot see a force; it is studied by noting its effects.		
(e) The weights of two bodies at a given place are always proportional to their masses.		
4. The mass of a body is the amount of matter it contains.		
(a) The unit of mass—the quantity of matter in a litre (1000 c.c.) of pure water at a temperature of 4 degrees C. (its maximum density). A stardard kilogram of mass is that which produce equilibrium with such a litre of water in the other pan.		
(b) The mass of a body may be considered as at the center of gravity.		
(i) Find the center of gravity of various bodies.		
(ii) Study examples of stable and unstable equilibrium.		
5. Forces acting within a liquid.		
(a) Pressure is defined as force per unit area.	V.	P. 71-74.
(b) Pressure due to liquids.	VI.	P. 22-44.
(c) Transmission of forces by liquids—Pascal's Law. Applications:		
(i) Hydraulic brake system of an automobile.		
(ii) Hydraulic press.		
(iii) Water pressure in fighting fire—the greater the water pressure, the greater the height to which a stream can be thrown.		
(iv) Automobile lift, barber's chair, hydraulic jack.		
(d) Relation between pressure and depth.		
(e) Artesian basins and wells.		
(f) Water wheels—overshot, undershot, breast and Pelton wheels, turbines.		
Problem 8.		
Why do steel ships float?		
1. Put cork, pine, aluminum, iron, potato, and an egg in fresh and salt water—note the behaviour of each.	I. IV. V.	P. 181-187. P. 67-69. P. 65-68.

Subject Matter	Reference	Section or Pages
2. Idea of density reviewed—compare the relative weights (buoyancy of a fluid depends upon its density).	VI. IX.	P. 44-71. P. 541-549.
3. Review the finding of the volume of irregular bodies. Use both graduate and overflow can.		
4. Find the volume of liquids—specific gravity bottle.		
5. Weight of bodies in air and in water.		
6. Displacement of water by objects.		
7. The principle of Archimedes.		
8. Application to balloons.		
9. General applications of this principle: the hydrometer, floating drydocks, the submarine, the flush tank, the rise of cream to the top of a bottle of milk, the floating of ice, icebergs, the floating of logs in the lumbering industry, the raising of wrecked vessels, sedimentation in rocks.		
Problem 9.		
Do gases have weight and do they exert pressure as does a liquid?		
1. The air surrounding the earth may be thought of as a sea of gas with the surface of the land and water forming the floor of this sea.	I. IV. V.	P. 206-234. P. 245-256, 270-274. P. 17-37.
2. Experiment to show that air has weight.	VI.	P. 72-107.
(a) Air is a real substance—evidence of its presence.	IX.	P. 7-30.
(b) The pull of gravity on gas molecules gives them weight in the same manner as it does when applied to liquid molecules.		
3. Because of this weight air is able to exert a pressure.		
(a) The measurement of atmospheric pressure —Torricelli's experiment.		
(b) Different types of barometers—their uses.		
(c) The siphon—its uses.		
(d) The lift pump and simple force pump—action and explanation.		
(e) The pneumatic tank plumbing system.		
(f) Method of measuring blood pressure—the manometer.		
(g) The air pump.		
(h) Applications—the parachute, Pyrene fire extinguisher, air brakes, pneumatic caisson, compressed air riveter, sail boats, wind mills, airplanes.		
4. Experiment to show the buoyant force of air.		
(a) The relation between atmospheric density and altitude.		

Subject Matter	Reference	Section or Pages

(b) Atmospheric buoyancy—balloons, airships, and dirigibles.

Problem 10.

How does a match burn?

1. The structure of a match—a careful observation of lighting and burning at different stages of combustion.
2. An experiment to show that heat is produced by friction.
3. Experiments on ignition temperatures of different substances—use an oven with an inside thermometer.
4. Brand's discovery of phosphorus.
5. The nature of the wood, presence of wax or paraffin, appearance of the head.
6. Dissolve the ends of matches in water, filter, evaporate, and compare the residue with potassium chlorate.
7. **With great care** (explosive reaction, must not be done in a closed vessel or even a test tube) heat a small quantity of (a) a mixture of charcoal and potassium chlorate; (b) sulphur and potassium chlorate.
8. Make a chemical match—mix potassium chlorate and granular sugar (with care) in a mortar. place a drop of sulphuric acid on the mixture (warning given).
9. Why is a strip of sandpaper put on each match box? Experiments using sandpaper, emery paper, wood, paper, cloth in warming a metal.
10. Read about how matches are made commercially, and find where in Canada they are manufactured. Where in Canada is phosphorus manufactured?
11. Warning regarding the handling of phosphorus—red and white (yellow) phosphorus.
12. Read about methods that primitive people have for making fire. Try some of them.
13. What is the nature of tinder?
14. Read the history of fire making. What people worship fire?
15. Without fire, what commodities would it be impossible to make?

Reference	Section or Pages
I.	P. 86-88.
II.	XXI—Fire and Fuels "Starting Fires".
IV.	P. 77-146.
V.	P. 1.
VII.	P. 372-376.
IX.	P. 42-53.

Problem 11.

Why and how do we prepare (cook) food by the aid of heat?

1. Compare a raw and cooked potato.
2. Discover the three distinct purposes of cooking:

Reference	Section or Pages
IV.	P. 219, 242-244, 308-309, 418, 504-506, 510-511, 513.

Subject Matter	Reference	Section or Pages
(a) To kill bacteria, yeasts, molds, and to check decay.	V. VIII.	P. 506-517. P. 261-289.
(b) To soften food and make it more digestible.	IX.	P. 190-254.
(c) To improve and develop the flavor of food.		
3. How may heat be transferred from one point to another? Experiments to show conduction, convection, radiation.		
4. The medium through which heat is carried in cooking:		
(a) Heated air—toasting bread, or broiling meat, fish, or eggs.		
(b) Water—boiling, simmering, or stewing.		
(c) Steam—steaming watery vegetables, fruit cakes and puddings, the pressure cooker.		
(d) Fat—can be heated to a higher temperature than water—doughnuts, deep fat frying.		
(e) The container itself—in pan boiling, waffle irons, and omelet pans.		
(f) Several mediums may be combined in baking and roasting. In fricasseeing, meat is partially fried and then the cooking process is completed by stewing and simmering.		
5. Digestibility of food—boiled, baked or broiled foods are more digestible than fried, sauteed, or fricasseed—Why?		
(a) Read about the digestion of starch, protein, and fats in a textbook in Biology.		
(b) Study the meaning of the terms: enzyme, hormone, gland secretion, peristaltic action, waste products.		
Problem 12.		
How are heat measurements made?		
1. The meaning of the term quantity of heat and the units B.T.U. and calorie (lesser and greater calories).	I. V. VI.	P. 260-268. P. 198-202. P. 295-326.
2. The construction and use of a calorimeter—specific heat.		
3. Changes of state—the nature of latent heat.		
4. Change of state from a solid to a liquid and vice versa—latent heat of fusion.		
5. Change of state from a liquid to a gas and vice versa—latent heat of vaporization.		
6. Freezing mixtures—common salt and ice, and others available. Applications.		
7. Sublimation—camphor, smelling salts, moth balls, dry ice, snow and ice.		
8. Heat of solution—effect of dissolved substances on the temperature of a liquid.		
9. The nature of evaporation—factors that affect the rate of evaporation, heat of vaporization.		

Subject Matter	Reference	Section or Pages
10. The relation between pressure and boiling temperature—how used to determine altitude.		
11. The nature of pressure cookers.	II.	XXIX—Producing Heat Economically
12. Practical applications of heat measurements.		
Problem 13.		
How can we obtain a knowledge of textiles?		
Note: This problem is divided into 7 sections. The 7 sections may be taken or a selection may be made at the discretion of the teacher.		
1. Cotton the world's most-used textile fiber.	III.	P. 37-59.
(a) Nature of a fiber—study a plant fiber.	IV.	P. 353-363.
(b) Long and short fibres—cotton the shortest of all the fibers used by man.	IX. IV.	P. 406-409. P. 361.
(c) World cotton production—United States, Egypt, India, South America.		
(d) How is cotton finished for the market?		
(i) A firm, full finish produced by use of much starch and pressing.		
(ii) A soft, supple finish is given by glycerine, fats or oils, and waxes.		
(iii) Stiffness is produced by treatments with mucilage and gums.		
(iv) Clay gives weight and a solid appearance to canvas and cretonne.		
(v) Cotton is made to look like linen by the use of dressings and by pressing with a marked roller.		
(vi) Cotton is made to look like wool—given a heavy nap to make it fuzzy and woolly in appearance.		
(vii) The mercerization process.		
(e) Consumer's guide when buying cotton goods.		
2. The nature of silk fibres.		
(a) Produced by an insect—a study of the silkworm including its life history.	IV. III.	P. 370-378. P. 111-129.
(b) Strength and size of the fiber—durable fabrics.	IX.	P. 406, 410-412.
(c) Preparation of the silk—gum removed by soaking fibers in boiling, soapy water, reeling, throwing.		
(d) Difference between reeled and spun silk and their uses in manufacture.		
(e) Weighting silk with tin compounds, rosin, and compounds of iron, lead, and chomium.		
(i) Test for weighted silk—burning and creasing tests.		
(ii) Effect of weighting—weaker fiber, cloth cracks, rots from sunshine and perspiration.		

Subject Matter	Reference	Section or Pages
(f) Differences between cultivated and wild silk (rajah, shantung, pongee).		
3. The nature of the wool fiber—scaly nature produces a strong thread.		
(a) Animals that produce wool—sheep, angora goat, camel, llama, alpaca. (Cashmere from a goat in Tibet.)		
(b) A study of length and quality of the wool fibers—uses of different wools.	III. IV.	P. 85-109. P. 361-370.
(c) Preparation of wool for cloth making—clipping, grading, washing in soapy water that contains sodium hydroxide, carding and combing.	IX.	P. 406, 409-410.
(d) Classification under woollen and worsted.		
4. A study of linen.		
(a) The flax industry—fiber for linen, seed for oil.	III. IV.	P. 61-72, 80-83. P. 378-383.
(b) A study of the flax plant.	IX.	P. 409.
(c) Retting—bacterial action—dew, pool, and steam retting.		
(d) Bleaching by sunlight.		
(e) Tests for linen.		
5. A study of rayon.		
(a) The nature of rayon.	II.	XXIV—New Giants in Industry.
(b) How rayon is produced.		
(c) The uses for rayon.	III.	P. 131-145.
(d) Source of the raw material—Canadian wood and American cotton.	IV.	P. 383-389, 417.
(e) Tests for rayon.		
6. Minor fibers and mineral fibers.		
(a) A brief study of kapok, known as tree cotton.		
(b) Hemp—used for making rope, canvas, and rough carpets.	III.	P. 147-161.
(c) Jute—burlap, sacking, twine, bindings.	IV.	P. 395-396.
(d) Coir—from husks of cocoanuts—door mats.	IX.	P. 409.
(e) Ramie—from China—for manufacture of a linen-like fabric.		
(f) Sisal—from Mexico—for manufacture of strong twine.		
(g) Asbestos—from a kind of rock—woven alone or with other fibers to provide fireproof and heat-resisting material such as shingles, clothing, curtains, electrical insulation, furnace and pipe covering, automobile brake-lining, wall board, paints, ropes and cement. Principal deposits in the Province of Quebec.		
7. Identifying tests for fibers.		
(a) Physical tests.	IV.	P. 389.
(b) Chemical tests.		

Subject Matter	Reference	Section or Pages
Problem 14.		
How does a clock keep time?		
1. Experiment with a simple pendulum—change length, weight and amplitude. Vibratory motion.		
2. Application of a force to the wheels by means of a spring or weights.		
3. Multiplication and reduction of rate of rotation of an axis by the use of cog or gear wheel.	I. IV.	P. 89-92. P. 606-608, 634-635, 804.
4. Regulation of pendulum (bob), escape wheel, and detent or lock; also rotation of wheels.	V.	P. 140.
5. Coefficient of expansion in metals. Experiments with compound bars—application in equalizing expansion and contraction in pendulum and balance wheel.	VI. IX.	P. 178-180, 226, 231-232. P. 441, 447, 562.
6. Other uses of the pendulum—metronome, ballistic pendulum. Students must have an elementary knowledge of gravitational force and understand the meaning of "g" in this formula: $\text{Time (of swings in seconds)} = 3.1416 \times \frac{\sqrt{\text{Length (in cm. or ft.)}}}{\sqrt{g \text{ (in cm. per sec.}^2 \text{ or ft. per sec.}^2)}}$		
7. Other uses of gear wheels—gear box of motor cars and other machines.		
8. Other methods of measuring time—sand glass, sun dial, etc.		
9. Electric clocks compared with spring and pendulum clocks.		
10. Longitude and time—siderial time, mean solar time, standard time.		
Problem 15.		
Why are some sounds annoying while other sounds are pleasing to us?		
1. The origin of sound.	I.	P. 390-426.
2. Transmission of sound—nature of sound waves.	III.	P. 159.
3. Velocity of sound in different media—how affected by the temperature of the medium.	II.	P. XXXIII—What the Sound Waves Bring Us.
4. Length and frequency of sound waves.		
5. The human ear—adaptations to receive vibrations and hear sounds.	V. VI.	P. 348. P. 344-381.
6. Echoes—reflection of sound waves, whispering galleries, broadcasting studios and auditoriums.	IX.	P. 31-38.
7. Amplification of sounds—sounding boards, beats, megaphone, stethoscope, speaking tubes.		
8. Sound insulations in buildings—the absorption coefficient of various materials.		
9. Loudness of sounds and how it is measured in decibels or phons (the sound-level meter).		
10. Nature of a musical sound—characteristics—pitch, intensity, quality.		

Subject Matter	Reference	Section or Pages
11. Limits of audibility—audio and radio frequencies —the value of supersonic vibrations for secret signaling under water.		
12. Sympathetic vibrations—resonators.		
13. An elementary study of musical instruments—strings, winds, percussion, reproducing instruments.		
14. A brief comparison of the principles in the pipe and the electric organ.		
Problem 16.		
What are the special lighting needs of our homes?		
1. Nature of light—wave theory and quantum theory.	I. IV.	P. 427-489. P. 542-543.
2. Good and bad effects of light.	V.	P. 253-295.
3. The requirements of good lighting.	VI.	P. 383-461.
4. Illumination:	IX.	P. 340-371.
(a) Light advances in straight lines under ordinary circumstances.		
(b) Intensity of illumination—law of inverse squares.		
(c) The standard lamp—English standard candle, the international candle.		
(d) The foot-candle meter and its uses.		
(e) Glare conditions—chief factors causing glares.		
(f) Types of interior lighting—semi-indirect lighting, regular reflection, and diffused reflection.		
5. Nature and source of color—due to reflected light.		
6. Responses of the eye to color—color blindness.		
7. Important factors in the science of seeing.		
Problem 17.		
How did fossils come to be in rocks?		
1. Examination of fossils, and layering of rock in which they were embedded.	I. V.	P. 60-85. P. 606-614.
2. Erosion, transportation, and deposition.	VIII.	P. 610-647.
3. Subsidence.	IX.	P. 169-171, 376.
4. Solidification by pressure, heat, and cementation.		
5. Hard parts preserved.		
6. Deposition under drifting sand or under mud.		
7. Fossil animals—dinosaurs, primitive birds, etc.		
8. What fossils teach about changes of level and changes of climate.		
9. Relation of fossils to existinng organisms.		
10. The search for and the reconstruction of the organism from its remains.		

Subject Matter	Reference	Section or Pages
Problem 18. How can we bring greater safety to our highways, homes, schools, factories, and industries? 1. The machine as a cause of accidents: defective brakes, defective steering mechanism, glaring headlights, one or both headlights out, tail light out or obscured, no chains, other defects in equipment, puncture or blowout. 2. The highway as a cause of accidents: railway and highway crossings, blind corners, curves, steep grades, unbanked turns, poorly marked roads, narrow brides or underpasses, poorly lighted streets and highways, hills, pavement dip or boils, loose sand or gravel, chuck-holes, washboard roads, seepage spots, mud holes, snow drifts, wet or ice surfaces. 3. The driver as a cause of accidents: ignorance and carelessness, disobedience to traffic laws, alcohol, disabilities, stepping from behind a parked car. 4. The pedestrian as a cause of accidents: jay walking, walking on highway, disabilities, crossing streets without obeying traffic regulations. 5. Speed of reaction in applying brakes. 6. Stopping distances. 7. Safe driving—good driving habits. 8. Traffic rules. 9. Accident prevention in home, school, factories, and industries such as flour mills and coal mines.	I. II. III. IV. IX.	P. 107. XXXIV—Safety on the Highway. XXXIV—Safety in the Home. P. 299. P. 725-822. P. 318-320.
Problem 19. Is the saying true, "Modern civilization hangs from a magnet"? 1. The history of magnetism. 2. Natural and artificial magnets. 3. The nature of a magnet. 4. The earth as a magnet. 5. Characteristics of magnets—poles, field of force, strength, magnetic induction, magnetic permeability. 6. The compass and its uses. 7. To magnetize an iron bar. 8. Magnetic shielding and magnetic transparency. 9. The electro-magnet—rules for determining the nature of the poles. 10. Uses made of the magnetic effect of the electric current—electric bell, electric motor, lifting magnet, telephone, telegraph.	I. II. IV. V. VI. IX.	P. 490-500. XI—Magnetism. P. 554-555, 561, 587-588, 815-817. P. 298-340. P. 473-496. P. 461-464.
Problem 20. How is electricity produced and how is it controlled for the use of mankind?		

Subject Matter

1. How is electricity produced—static and chemical electricity, electro-magnetic induction.
2. Relation of magnetism and electricity.
3. The electric generator—the dynamo.
4. The electric cell—the storage battery, dry cell.
5. Electrostatic electricity.
6. Measuring electricity.
7. Law of electricity—Ohm's Law and its application—determine the power consumption of various electrical applications.
8. Conducting electricity—two types of electrical circuits, series and parallel.
9. Safety factors—fuses, wiring, plugs, etc.
10. Electric heating and lighting appliances.

Reference	Section or Pages
I.	P. 503-543, 566-576.
II.	P. XIII—How Electricity is Produced XIV—Measuring Electricity.
IV.	P. See Index—"Electricity".
V.	P. 296-360.
VI.	P. 463-472, 497-598.
IX.	P. 318, 452-482.

GENERAL SCIENCE 2.

***Problem 1.**

Where did chemistry come from and what is its place today in our lives?

1. The chemistry of yesterday:
   - (a) The contribution made by various nations to chemistry.
   - (b) What metals did the ancients have?
   - (c) Who and what were the alchemists, and what contribution did they make?
   - (d) The nature of burning to men of the 18th century; phlogiston.
   - (e) The discovery of oxygen by Priestley, 1774.
2. The chemistry of today:
   - (a) Changes (physical and chemical).
     - (i) What they are and factors involving them—explained in terms of the arrangement of the molecules and the arrangement of atoms within the molecule.
     - (ii) Catalysis and catalyzers and their relation to chemical change.
   - (b) New material from living and from lifeless matter.
   - (c) Chemistry as related to our daily life: health, preparation of food, preservation of food, air conditioning, control and prevention of disease.
   - (d) Relation of chemistry to industry.
     - (i) Makes waste products into useful substances.
     - (ii) Chemistry has cheapened expensive substances.
     - (iii) Chemistry has improved many useful things. Wider use of steel and alum-

Reference	Section or Pages
I.	P. 269-272.
II.	II—Applied Chemistry. XIX—The Mysterious Behaviour of Matter.
V.	P. 125.
VII.	P. 2-22.
VIII.	P. 266-267.
IX.	P. 46, 48.

Subject Matter	Reference	Section or Pages
inum; progress with rubber and glass—special forms of glass: lead, health (quartz and silica), shatterproof, optical; progress in the use of synthetic textiles; on the farm—fertilizers, sprays for blights and insects.		
(e) Relation of chemistry to other sciences.		
(f) What chemistry offers to youth.		
***Problem 2.**		
What is matter and how is it classified?		
Note: Scientists have reduced the make-up of the world to just two realities: matter and energy. Energy is the foundation idea of physical knowledge, matter is considered as the means [illegible] is transformed.		
1. Nature of matter—three states of matter.	I.	P. 269, 273-280, 284.
(a) Nature of an element—few of the 92 elements are found alone in nature.	II.	XIX—The Mysterious Behaviour of Matter.
(i) Properties of an element.		
(ii) Scarcity or abundance of different elements.	V. VI.	P. 95-111. P. 3, 11.
(iii) How the elements are named.	VII.	P. 24-39, 53-62.
(iv) The chemist's shorthand for the elements.	IX.	P. 9, 55, 285, 452.
(b) Nature of a compound—two or more elements united chemically.		
(i) Properties of a compound compared with those of composing elements.		
(ii) Law of definite composition or proportion.		
(iii) Chemist's shorthand for compounds—application to molecules and atoms, formula.		
(iv) Evidence for atoms and molecules.		
(v) Nature of chemical affinity.		
(c) Nature of a mixture—composed of elements or compounds or of both.		
(i) Properties of mixtures.		
(ii) Examples—milk, air, butter, etc.		
2. How the chemist represents chemical change—the equation.		
(a) How molecules and atoms are designated.		
(b) The balance—the number and kind of atoms with which we begin is equal to the number and kind of atoms with which we finish.		
(c) Different types of reactions—reduction, decomposition, replacement.		
3. The nature of energy—defined.		

Subject Matter	Reference	Section or Pages
(a) Kinds of energy—mechanical or motion, light, heat, chemical, electric.		
(b) Law of the conservation of energy.		
(c) Transformation of energy.		
(d) Three companions of chemical change—heat, light, electricity.		
(e) Measuring chemical energy in terms of heat energy—calories.		
(f) Heat of fusion and heat of vaporization—applications.		
4. How are chemical reactions brought about? Agencies—heat, light, electricity, contact, solution. Simple examples of each.		
***Problem 3.**		
What is a solution?		
1. Solutions as one class of mixtures—solvent and solute .	I.	P. 12, 161, 169, 275, 276, 331, 332.
2. A solution explained in terms of scattered molecules (kinetic-molecular hypothesis).	V. VI.	P. 100-103, 108-109. P. 304.
3. Solutions differ from chemical compounds.	VII.	P. 63-77.
4. Different powers of different solvents—water, gasoline, alcohol, carbon disulphide, carbon tetrachloride.	VIII. IX.	P. 199, 263, 273, 287, 292, 551, 552. P. 133, 414-416, 420.
5. Degrees of solution—dilute, concentrated, saturated, supersaturated.		
6. The different kinds of solutions—a solid in a liquid (such liquids are said to be miscible), solid in a solid.		
7. Things that affect solubility—nature of the solute, nature of the solvent, temperature, pressure.		
8. Boiling and freezing point of a solvent affected by the presence of a dissolved substance—antifreeze mixtures.		
9. Hydrates and water of hydration—efflorescence and deliquescence.		
10. Osmosis—semipermeable membrane, osmotic pressure, application in plants.		
11. Electrolysis of solutions—industrial importance.		
12. Separation of solutions by fractional distillation and by crystallization.		
***Problem 4.**		
Since we live in a sea of air, what should we know about it?		
1. Some results of living at the bottom of the atmosphere.	I. II.	P. 7, 192. XX—The Chemical Reservoir.
2. An analysis of air—air is a mixture.		
3. Oxygen—the most abundant element.	V.	P. 39-58.
(a) Discovery by Priestley.	VI.	P. 72-73.

Subject Matter	Reference	Section or Pages
(b) Preparation of oxygen.	VII.	P. 276-287, 79-100, 101-136, 148-160, 266-275.
(c) Properties of oxygen—test.		
(d) Nature and importance of oxidation—oxygen the breath of life, rapid and slow oxidation, harmful oxidation and how it is prevented.	IX.	P. 43-48, 83-84, 49-56, 280.
(e) Commercial uses of oxygen.		
4. Nitrogen—the inactive part of the atmosphere.		
(a) Preparation of nitrogen (i) from air, (ii) from compounds of nitrogen.		
(b) Properties of nitrogen.		
(c) Uses of nitrogen in industry—compounds of nitrogen; explosives, ammonia, fertilizers, nitrogen fixation, the nitrogen cycle.		
5. Carbon dioxide—all plants and animals depend on carbon.		
(a) Preparation of carbon dioxide—test.		
(b) Properties of carbon dioxide.		
(c) Uses of carbon dioxide—in plant life, as a refrigerant, in fire extinguishers, in soda water.		
6. Water vapor.		
(a) The composition of water.		
(b) Preparation of hydrogen—test.		
(c) Properties of hydrogen.		
(d) Economic importance of hydrogen.		
(e) Relation of humidity to life—in forests, homes, industry.		
***Problem 5.**		
How can we obtain a knowledge of acids, bases, and salts.		
2. Properties common to all acids.	I.	P. 319-337.
(a) Test for an acid.	II.	XXII—The Big Three of Chemical Compounds.
(b) Definition of an acid—organic and inorganic acids.		
(c) How acids are named.	IV.	P. 71-72.
(d) The importance of sulphuric, hydrochloric, and nitric acids.	V. VII.	P. 118-119, 313. P. 240-250.
(e) Dangers when handling acids.	IX.	P. 180, 186.
(f) Acid soils and how to correct them.		
3. Properties common to all bases.		
(a) Test for a base.		
(b) Definition of a base.		
(c) The nature of alkalies—alkali soil, how formed and how corrected.		
(d) Preparation of the bases: calcium hydroxide, sodium hydroxide, ammonium hydroxide.		
4. Preparation and study of salts.		
(a) Nature of neutralization—two poisons become harmless: $HCl+NaOH=NaCl+H_2O$.		

Subject Matter	Reference	Section or Pages
(b) Where salts are formed.		
(c) How salts are named.		
(d) Study of some important salts—sodium chloride, sodium carbonate, sodium bicarbonate.		
Problem 6.		
What can we learn that will assist us in laundering and in stain removal?		
1. What is the nature of soap?	I.	P. 166-167, 170.
(a) How is soap manufactured?	II.	XXII—Soap Making to Scouring Powders.
(b) How does soap assist in the removal of dirt?		
(c) What are washing powders?		
2. Hard and soft water.	III.	P. 94, 38, 71, 99, 123, 135, 209, 450-453, 472.
(a) Temporary and permanent hardness—nature and causes.		
(b) Test for hardness.	IV.	P. 8, 22-24, 372, 390-394, 403, 458, 503, 508, 511, 524, 526, 569.
(c) Water softening.		
3. Laundering such materials as wool, linen, silk, cotton, rayon; special precautions needed.		
4. Stains and their removal.	V.	P. 88, 91, 101, 103, 124-125, 128-129.
Experiments—by absorption, by bleaching, by neutralization, by solution.	IX.	P. 413, 419.
Problem 7.		
How are photographs made?		
1. What makes photography possible?	I.	P. 431-432, 456, 476.
(a) Characteristics of light.	II.	XXXIII—Photography for Everybody.
(b) How a lens forms an image.		
(c) Study of a camera—box, lens, shutter, focusing scale, diaphragm.	III.	P. 303, 369, 377.
(d) Study of a film—cellophane coated with gelatin containing a silver salt compound.	IV. V.	P. 571-574, 585-586. P. 254, 273-278, 282, 276, 387-390, 359.
(e) Study of lens speeds.		
(f) Developing and fixing the film.	VI.	P. 391, 624.
(g) Printing pictures from negatives.	VII.	P. 465, 597-600.
2. Other phases of photography.	VIII.	P. 10, 12, 178.
(a) Different kinds of lenses and lenses for special purposes—telephoto, copying, portrait lenses, and sky filters.	IX.	P. 350-354, 537.
(b) Composition of a picture.		
(c) Enlarging pictures.		
(d) The principle of motion pictures.		
(e) Colored photography.		
(f) Types of photography—trick, night, candid, through the microscope.		
Problem 8.		
What should we know about the foods we eat?		
1. What is food? The nature of proteins, fats, carbohydrates, minerals, vitamines, water. Foods rich in each.	II.	P. XXXI—Refrigeration and Air Conditioning.

Subject Matter

2. Food legislation—pure food laws. Three types of legislation: to prevent adulteration, to prevent misbranding, to maintain sanitary conditions for food. (Study local conditions.)
3. The grains and their uses.
4. How meats are inspected and graded.
5. How dairy products are inspected and graded.
6. Grading of eggs—eggs as food, preservation of eggs.
7. Fish—characteristics of fresh fish, canned fish.
8. Vegetables—fresh and canned.
9. Fruits—fresh and canned, cold storage, the preservation and marketing of frozen fruit.
10. Beverages—tea, coffee, chocolate, cocoa, postum, soft drinks.
11. Miscellaneous foods—sugar, honey, jams, jellies, spices, flavourings, salad dressing, gelatin.
12. Use of chemical preservatives—benzoate of soda, potassium permanganate, borax, formaldehyde, salicylic acid.
13. Adulterated foods—glucose for cane or beet sugar, cereals for meat in sausages, dyes in candies and jellies, bacon post-cured with salt, flavouring to conceal adulteration.

Reference	Section or Pages
III.	P. 455-505.
IV.	P. 277-350.
V.	P. 365, 471-508, 572.
VII.	P. 383, 475, 489, 490, 491, 493-495.
VIII.	See Index—"Foods."
IX.	P. 190-282.

Problem 9.

Is a knowledge of oils and their uses valuable to us?

1. The history of petroleum—theories to account for oil fields.
2. How oil is recovered from the rocks—Turner Valley.
   (a) Study of the rock formations.
   (b) The log of an oil well.
3. The uses for petroleum oils.
4. Gasoline—meaning of octane number, knock, ethyl, refined, etc.
5. Lubricating oils—nature of lubrication, viscosity and viscosity index.
6. Fractional distillation—analysis of oils.
7. Miscellaneous oils. (See II—405-423.)

Reference	Section or Pages
I.	P. 366-368.
III.	P. 397,423.
IV.	P. See Index—"Oil".
V.	P. 190-191, 219, 265.
VII.	P. 432, 480-482.
IX.	P. 378-390.
II.	XXV—Automobile Lubrication.

Problem 10.

Why is a study of the colloidal state important?

Note: Bancroft calls colloid chemistry "the chemistry of everyday life".

1. Colloidal state: colloidal systems.
   (a) Nature of colloidal particles—always electrically charged.
   (b) How colloidal dispersions are made.
   (c) Properties of colloidal dispersions.

Reference	Section or Pages
II.	XXIV—New Giants in Industry—Synthetics.
VII.	P. 410-426.
VIII.	P. 551-553, 556, 571.

Subject Matter	Reference	Section or Pages
(d) Coagulation of colloidal dispersions.		
(e) Colloids and crystallizations.		
(f) Various kinds of colloidal dispersions.		
(g) Absorption.		
(h) Emulsions and emulsifying agents.		
(i) Jellies, smokes, coloration.		
2. A study of rubber from tree to manufactured article.		
(a) Latex an emulsion.		
(b) How rubber is separated from latex.		
3. An elementary study of plastics—bakelite.		
4. General applications of colloidal substances to industry.		
(a) Milk is an emulsion of butterfat in water with casein the emulsifying agent.		
(b) Common disinfectants—cresylic acid emulsified in water with a small percentage of soap as the emulsifying agent.		
(c) Mayonnaise—olive oil is emulsified in water by the colloidal yolk of egg.		
(d) The secretions of spiders and silkworms are emulsions.		
(e) Explosives, photographic **films.**		
Problem 11.		
What is the nature of the fuels we use, and how can we heat our buildings economically?		
1. An elementary survey of the common fuels: wood, coal, coke, petroleum, natural gas, illuminating gas.	I. III. IV.	P. 362-372. P. 397-424. P. 149-214.
2. Wood as a fuel—compared with different grades of coal.	VII. IX.	P. 145, 428-453. P. 374-380.
3. Coal as a fuel.		
(a) The story of coal.		
(b) The nature of lignite, bituminous, and anthracite coal.		
(c) To analyze a sample of coal (I.—P. 363-4).		
(d) Economy in firing methods (II.—XXIX.—Producing Heat Economically).		
(e) Prices of coal versus cost per B.T.U. Use of formula. Reference as in (d).		
4. Coke as a fuel.		
(a) Production of coke—experiment (I.—P. 364).		
(b) Nature and yield of destructive distillation.		
(c) A favourite foundry fuel.		
5. Petroleum as a fuel.		
(a) The distillation of crude oil—(I.—P. 367).		
(b) Fuel oil—oil burners, principle of the Diesel engine.		
(c) Uses of petroleum products (IV.—P. 190).		

Subject Matter	Reference	Section or Pages
6. Natural gas as a fuel.		
(a) The nature of the natural gas found in Alberta.		
(b) How to burn natural gas—dangers.		
(c) Moisture content in natural gas.		
(d) How sold to the consumer.		
7. Artificial gas—coal gas, acetylene.		
(a) How produced. (b) Uses.		
8. Comparative fuel values—coal, fuel oil, natural gas, artificial gas, wood, electricity. (See II.—Cheaper Fuels Than Coal.)		
Problem 12.		
Are you interested in life, its origin and betterment?	IV. V. VIII. IX.	P. 320-350. P. 361-418, 559-578. P. 408-499, 580-609. P. 576-602.
1. All life comes from life—cells can come only from cells .		
(a) The nature of a cell—an animal cell compared with a plant cell.		
(b) A one-celled animal (Amoeba) compared with a one-celled plant (Spirogyra).		
(c) Methods of reproduction—cell division, sexual and asexual reproduction.		
(i) Seeds and eggs compared.		
(ii) Reproduction by means of seed formation—study of a flower, its parts and their work, pollination, fertilization.		
(iii) Compare the seed of corn with the seed of a bean.		
(iv) Reproduction in higher forms of animals.		
2. The struggle for existence and the survival of the fittest.		
(a) A field trip to observe this struggle.		
(b) How seeds are spread.		
(c) The meaning of heredity.		
(d) The meaning of variation.		
(e) The meaning of selection.		
3. Improving living conditions.		
(a) The rise of the science of bacteriology and its importance to mankind.		
(b) Preventive medicine.		
(i) Vaccination against smallpox.		
(ii) Inoculation against typhoid fever.		
(c) Improving living conditions.		
4. The balance of nature.		
(a) A balanced aquarium (V.—P. 575; IX.—P. 6).		
(b) How changes in balance are brought about.		
(c) Relationships with mutual benefits.		
(d) Parasites and saprophytes.		

Subject Matter	Reference	Section or Pages
Problem 13.		
How did man obtain our cultivated plants?		
1. Names as keys—China Aster, African Daisy, Marvel of Peru, Japanese Cherry, etc.	VIII.	P. 129-157, 648-743. 13-24.
2. Plant collectors: Hooker, Banks, De Candolle, Kew Gardens, U. S. Department of Agriculture, Dominion Botanist, Ottawa; Mr. W. C. McCalla, of Calgary.		See also reference books in Biology; especially *Agriculture for High Schools.*
3. Relation of habit of flowering to origin.		
4. Plants first cultivated for food, later for medicines.		
5. Origin of some common cultivated plants.		
6. Creation of new varieties by man.		
7. Acclimatization.		
9. History of the cultivation of wheat, corn, potato, orange, etc.		
Problem 14.		
Why are metals called "the framework of modern life"?		
1. The history of metals.	I.	P. 285-286, 291.
2. What metals are most needed today?	II	XXIII—Metals More Valuable Than Gold.
3. A very brief study of the nature and uses of the more important metals in use today.		
4. Judging metal goods (III.—P. 345).	III.	P. 327-347.
5. Alloys—man-made metals.	IV.	See Index.
(a) What is an alloy?		P. 492-494.
(b) The advantages of alloys.	VII.	P. 499-562, 572-626.
(c) Metals used as alloys:— nickel, chromium, tungsten, cobalt, manganese, Wood's metals, etc.	X.	P. 281-300.
Problem 15.		
What should we know about the radio?	I.	P. 580-585.
1. The beginning of the radio and its progress.	II.	XVIII—The Magic of Communication. XXXIII—What Sound Waves Bring Us (Buying Radios).
2. General principles—wave length, frequency, tuning, modulation, velocity of radio waves, transmission, interference.		
3. How to operate a radio set.		
4. Parts of a receiving set and their function.		
5. Why reception is not always perfect—fading, static, man-made disturbances, improper installation.	V. VI. IV.	P. 345-360. P. 599-610. P. 562-567, 706-707, 226, 588-589.
6. Points to note when buying a radio or radio parts.	IX.	P. 501-539.
Problem 16.		
What is paint and how is it used?	II.	XX—The Chemical Reservoir (Oxygen the Destroyer).
1. The history of paint.		
2. What are the constituents of paint?		
3. How paint is made.		
4. Paints for special uses.	III.	P. 339, 403, 425-445.

Subject Matter	Reference	Section or Pages
5. Stains, their composition and uses.	IV.	P. 84, 208, 230, 248-249, 379, 479-489, 519, 799-801, 811.
6. Varnishes—oil and spirit varnishes.		
7. Lacquer.		
8. Uses of paints and varnishes.		
9. Lead poisoning .	V.	P. 130.
10. The chemist speeds up the drying process.	VII.	P. 608-611.
Problem 17.		
Does a study of chemistry help us on the farm?		
1. The importance of soils and fertilizers.	III.	P. 471-481.
(a) Different kinds of soils.	VII.	P. 381-388.
(b) What foods do plants need?	IV.	P. 246-250, 150, 612, 762.
(c) Sources of the constituents of fertilizers—commercial fertilizers.	VII.	P. 458-462.
2. Milk is the chief product of a dairy farm.		
Note: This section is well covered in *Agriculture for High Schools* by Andrews, W. J. Gage Co., 1937, pp. 258-278.		
(a) Average composition of cow's milk.		
(b) Pasteurization of milk.		
(c) Babcock test for butterfat content—principle of the centrifuge. Cream tests.		
(d) The methylene blue test for bacterial growth.		
(e) Butter and cheese making.		
(f) The vacuum milker—principle involved.		
(g) Condensed, evaporated, and powdered milk.		
(h) Tests for acidity, specific gravity, and total solids by evaporation.		
3. The feeding of live stock.		See *Agriculture for High Schools.*
(a) The function of plant constituents in feeds: fiber, proteins, carbohydrates, fats, mineral matter.		
(b) A study of common feeds—concentrates and roughages.		
(c) Selecting a ration.		
4. The storage battery—for radio, lighting and automobile.	V. VI.	P. 309-314. P. 510-511.
Galvanic electricity—(i) make a simple electric cell; (ii) examine the parts of a dry cell; (iii) connect cells to form a battery; (iv) make a simple storage cell; (v) test a battery with a hydrometer; (vi) charge a storage battery—principle involved; (vii) difference between direct and alternating currents.	VII. IX.	P. 606. P. 455-461.
Problem 18.		
Why should we be interested in the chemistry of digestion?	I.	P. 17-18.

Subject Matter	Reference	Section or Pages
1. Where do assimilation and oxidation of feed go on? 2. In what form must nutrients be in order to enter a cell? 3. What further change must take place in nutrients before they can be used by a cell? 4. By what means are nutrients digested? 5. How does the human body prepare its food for use in the cell? 6. How is food changed in the mouth, stomach, and small intestine? 7. Where do the digested foods go? 8. Where are the various digestive glands located and how are they stirred into action? 9. What becomes of nondigestible food? 10. Experiments to be performed (VIII.—P. 279-281).	III. IV. V. VII. VIII. IX.	P. 455-462. P. 283-291, 320. P. 509-517. P. 471-472. P. 261-289. P. 251-256.
Problem 19. What should we know about drugs, poisons, and cosmetics? **Note:** This problem is well covered in *Descriptive Chemistry* by Wilson (Clarke, Irwin Co.). 1. A study of drugs. (a) Medicine formerly associated with superstition. (b) Drugs from plants. (c) Drugs from animals. (d) Drugs from minerals. (e) Drugs from nonmetals. (f) Synthetic drugs. (g) Patent medicines—good and bad. (h) Pure Food and Drug Act. 2. A study of some poisons and their antidotes. (a) Absorption of poisonous gases—illuminating gas, automobile exhaust, gas from coal stoves. (b) Accidental poisoning (except gas). (i) Mistaking poison for medicine. (ii) Overdoses of medicine containing poisons—atropine, veronal, acetanilide, opium, morphine, laudanum. (iii) Mistaking wood or denatured alcohol for grain alcohol. (iv) Carelessness—strychnine, arsenic compounds, kerosene, lye, oil of wintergreen, acetic acid, carbolic acid. 3. Food poisoning. (a) Due to products of decay or growth of organisms in food—ptomaines. (b) Mushrooms. (c) Botulism and similar poisoning.	III. V. VIII. X.	P. 443-454. P. 480-481. P. 148, 260,478, 483, 486, 538, 546-547. P. 185-223.

Subject Matter	Reference	Section or Pages
Problem 20.		
How can we become problem seekers and problem solvers?		
1. The nature of research.	II.	III—Solving Science Problems—How is Scientific Thinking Done.
2. The technique of research—the scientific method.		
3. Each student selects a problem for himself in consultation with the teacher. The student carries out individual research on his problem and carries his thinking to logical conclusions. This is the work-shop technique. A complete report is made, including drawings of apparatus used. A bibliography with page references is made.	III. V. VIII. IX.	P. 3-11. P. 1-15. P. 167-168. P. 615-616.

Example: What is the nature of tooth paste and tooth powder?

1. Ask local merchants the names of brands of tooth paste or tooth powders. Discover the three best sellers. Purchase a small tube of one of these three.
2. From your reference library discover the ingredients of tooth powders or pastes—salt, sodium perborate, sodium bicarbonate, magnesia, pumice, chalk, borax, starch, orris-root, dicalcium phosphate, bleachers, flavor.
3. Study each of these ingredients and discover why it is used in tooth paste. List its properties and a test for it.
4. Study the nature of analysis.
5. Analysis of the sample of tooth paste.
6. A complete report of the research.

Suggested problems:

1. What may be learned from stumps of trees?
2. What is the nature of magnetic force?
3. To discover the density of several liquids and to show how this density affects the use of the liquid.
4. The common woods of Alberta—samples and a description of the habitat, fruit and leaves of each tree.
5. How can copper etching be done with nitric acid?

These are types; other problems may be suggested by student or teacher.

GEOLOGY

INTRODUCTION.

> "Never before has the average person had so wide an opportunity of coming into contact with the diverse aspects of nature as is afforded him to-day, through the use of the automobile. River valleys, gorges, waterfalls, divides, meandering brooks, cliffs, lake shores, waves, tidal marshes, mountain peaks, and mountain parks; each and every topographic phenomenon has for most people a degree of significance it never had before."—Introduction, *New Physical Geography.*

A study of the geology of Canada is necessary to throw light upon its physical geography. Geologists have been also geographers, for they have been compelled to explore and map a great wilderness, in order to study and record its geology. A gradual evolution has brought our lands to the present extent and form, and an equally prolonged development has given the present population of plants and animals, and has set man himself to take advantage of the vast resources of this northern half of the continent.

Geology 1.

The purpose of this course is not to make geologists of the students. but to develop powers to observe those things that lie at their very feet, and to help them to interpret those things, as signs of one of the newest parts of the earth, against the geological history of the earth.

Teachers must make a common-sense interpretation of this outline and avoid a too intensive treatment of the content. While a body of factual knowledge is desirable, teachers should strive for understanding and appreciation of the forces of nature that surround us, and of the vast changes that have taken place, and are continuing to take place, in our earth.

No textbook to be purchased by the student has been authorized by the Department of Education. Surround the student, if possible, with good reference books and periodicals, such as *The National Geographic Magazine* and *The Canadian Geographic Magazine*, and allow him to receive the joy that comes from discovery; and to partake of the search, organization, and understanding that must accompany research work. Have the students make collections of specimens and pictures for illustrative purposes. Field excursions, properly organized and conducted, should be made frequently.

New Physical Geography, by Tarr and von Engeln (Macmillan Company), was used extensively when the Course was outlined, and should be made available to the students as a reference work. *The Ontario High School Physical Geography,* by Gilbert and Brigham (Macmillan Company, 1921), once used in Alberta as a textbook, contains much useful information, in that the background is Canada. The Chapter on The Geological History of Canada is very helpful.

N.B.—This outline is purely tentative, and is subject to revision. Teachers may select from it as much material as their classes can cover in a year's work. Emphasis should be placed on the geology of Alberta.

REPORTS FROM THE UNIVERSITY OF ALBERTA AVAILABLE TO TEACHERS OF GEOLOGY

The list of reports recommended to teachers of Geology and set forth on page 60 of the "High School Regulations, for the year 1937-38, has now been revised. Teachers are asked to disregard the old list and refer to the list following, all the items of which, save the last, are to be had from the **Department of Geology, University of Alberta (not from the School-book Branch).**

Reports—Geological Survey Division

No. 1 (1919) pp. 104—A summary of information with regard to the mineral resources of Alberta, by J. A. Allan. **Price 35 cents.**

No. 2 (1920) pp. 138 & 14. Supplements the information contained in Report No. 1, by J. A. Allan. **Price 50 cents.**

No. 11 (1924); Geology of the Foothills Belt Between McLeod and Athabaska Rivers, Alberta; R. L. Rutherford; pp. 61 and 8-colour map (Serial No. 7). One inch to two miles. Continuation of the area described in Report No. 9. **Price 50 cents.**

No. 15 (1926); Geology of the Area Between Athabaska and Embarras Rivers, Alberta, by R. L. Rutherford; pp. 29 and 3-color map (Serial No. 11). One inch to two miles. Eastward extension of field survey described in Report No. 11. **Price 50 cents.**

No. 17 (1927); Geology along Bow River between Cochrane and Kananaskis, Alberta, by R. L. Rutherford, pp. 46 and 9-colour map (Serial No. 12). Scale 1 inch to 1 mile. **Price 75 cents,** or map alone, **25 cents.**

No. 19 (1928); Geology of the Area between North Saskatchewan and McLeod Rivers, Alberta, by R. L. Rutherford; pp. 37 and 3-colour map (Serial No. 13). Scale 1 inch to 3 miles. **Price 25 cents.**

No. 21 (1930); Geology and Water Resources in Parts of Peace River and Grande Prairie Districts, Alberta, by R. L.

Rutherford; pp. 80 and 6-colour map (Serial No. 14). Scale 1 inch to 4 miles. **Price 75 cents.**

Black and white geological map of Alberta, **Price 5 cents.**

Map No. 16 (1937); Geological Map of Alberta, by J. A. Allan. In 14 colours. Scale one inch to 16 miles. **Price 75 cents.**

This map is distributed by the Department of Lands and Mines, Edmonton

REFERENCE BOOKS.

Tarr and von Engeln: *New Physical Geography* (The Macmillan Company).

Cornish and Whyte: *Ontario High School Physical Geography* (1923) (The Ryerson Press).

Allen and Ferguson: *Elementary Science* (The Ryerson Press). Chapters III, V, VI, IX, X, XVI, XXIII.

Coleman and Parks: *Elementary Geology* (Dent & Sons).

I.—GENERAL FEATURES OF THE EARTH.

The earth's present surface is the result of two opposing forces: (1) those tending to build it up; and (2) those tending to wear it down. Earthquakes, volcanoes, and crustal movements tend to build the earth's surface up above the sea level. Rain, rivers, frost, waves, and winds tend, in general, to wear down the surface. In the following outline the teacher is asked to lay particular stress on the way in which each factor listed has a definite place in the operation of these physical forces.

A.—The Gaseous Envelope or Atmosphere.

Very briefly review the following:

1. Composition and function of air.
2. Weight and height of the atmosphere.
3. Humidity of the air.
4. Rain and snow—
    - (a) Measuring rainfall.
    - (b) Ratio between rainfall and evaporation.
5. Temperature of the atmosphere—
    - (a) Sources of heat in the atmosphere.
    - (b) Modes of warming and cooling—
        - (1) Radiant energy: (a) passage of radiant energy; transparent and diathermanous substances; (b) radiation from the earth; compare soil, water, and rock as radiators; (c) reflection and absorption of heat.
        - (2) Conduction: (a) compare water, air, ground, and iron as conductors of heat; (b) warming of soil and bodies of water.

        - (3) Convection: (a) nature of convection currents in (i) air; (ii) water; (b) chief originating cause of winds; heat from the sun; (c) insulation; dead air spaces.
    - (c) Causes for differences in temperatures of the earth—
        - (1) Position of the sun in the heavens: (a) from morning to night; (b) from season to season; (c) from place to place.
        - (2) Altitude.
        - (3) Nature of the soil; warm and cold soils.
        - (4) Exposure; north slopes, and sunny south slopes; hilltops and valleys.
        - (5) Influence of bodies of water.
        - (6) Nature and direction of the wind.
    - (d) The mapping of temperature; isotherms.

B.—The Liquid Ocean, or Hydrosphere.

1. Importance of the ocean to mankind.
2. Oceanography—
    - (a) Instruments used in exploring the oceans—
        - (1) Hayes sonic apparatus, for depth.
        - (2) Deep-sea dredge, or trawl, for obtaining sea-life.
        - (3) Water bottle, and thermometer.
3. Ocean basins; the sea-floor—
    - (a) Nature of the sea-floor.
    - (b) Deposits on the ocean bottom—
        - (1) Rock fragments.
        - (2) Ocean-bottom oozes; globigerina ooze; diatom ooze; radiolaria; pteropod ooze.
        - (3) Red clay:—composition; decomposed volcanic dust and shell remnants.
    - (c) Continental shelf, and continental slope.
    - (d) The ocean water—
        - (1) Composition of sea water.
        - (2) Density and pressure of sea water.
        - (3) Temperature of the ocean.
    - (e) Movements of the ocean waters—
        - (1) Wind waves: (a) nature of wind waves; energy and form move forward; (b) rollers, or ground swell; (c) surf, or breakers; (d) undertow.
        - (2) Other waves:—earthquake waves; iceberg waves; hurricane waves.
        - (3) Tides: (a) cause of tides; (b) high tide, and low tide; spring tides, and neap tides; (c) tide-tables; (d) tidal wave, or "bore"; (e) tidal currents—

(i) drift sediment about, helping to form sedimentary strata; (ii) produce a circulation in harbours, helping to remove sewage, filth, etc.; (iii) aid or impede navigation.

(4) Ocean currents: (a) causes of surface currents—(i) difference in temperature of ocean water; (ii) wind-drift current; (b) principal ocean currents: Equatorial Drift; Sargasso Sea; Gulf Stream; North Atlantic Eddy; West Wind Drift; Pacific Eddies; Japan Current; Labrador Current.

(5) Effects of ocean currents: (a) on climate; (b) aid or retard vessels; (c) cause fogs; (d) drifting sea ice, and icebergs; (e) bring oxygen and food for many sea animals.

(6) Ice in the ocean: (a) Arctic sea icebergs and floes drift southward in the Labrador Current; (b) icebergs from the Greenland Ice Sheet drift into the Arctic, and from the Great Ice Barrier into the Antarctic.

(f) Coral reefs:—fringing reefs; barrier reefs; atolls.

C.—The Solid Rock Crust, or Lithosphere.

1. Man has learned many facts about the lithosphere from mountains, rivers, valleys, tunnels, quarries, mines, and well borings.

2. Nature of the lithosphere—

(a) Mantle rock (soil mantle), and bed rock.

(b) Rocks of the crust—

(1) Sedimentary rocks: (a) assorting action of waves and currents; (b) binding by mineral cements, and by pressure; (c) examples to be studied:—sandstones; shales; limestones; conglomerate; chemically formed rocks, as salt, gypsum, stalactite; organic rocks, as most limestones, coal (bituminous, lignite, peat).

(2) Igneous rocks: (a) origin of such rocks: (i) igneous rocks of the surface; (ii) intruded igneous rock—dike, sheet or sill, bosses, batholiths; (b) examples to be studied:—granite, diabase, and basalt.

(3) Metamorphic rocks: (a) origin of such rocks:—(i) quartzite—altered sandstones; (ii) slate—altered clay rock; (iii) marble—altered limestone; (iv) anthracite—altered coal; (v) schist—altered from various rocks; (vi) gneiss—altered from various rocks; (b) study samples of the above rocks.

(c) Resistance of rocks—

(1) Durable rocks; hills, ridges, peaks,—mainly sandstone, quartzite, and granite.

- (2) Weak rocks; valleys formed,—limestone, marble.
- (3) Agents of weathering:—percolating water, air, and the action of animals and plants.
- (4) Rate of weathering; varies with the rock, climate, exposure, and steepness of slope.
- (5) Results of weathering; residual soil; transported soil; dissolved mineral substances; talus; landslides; soil creep; formation of sedimentary strata; valley broadening; rock sculpturing.
- (6) Agents of erosion:—wind; rivers; oceans; lakes; glaciers.
- (7) Denudation; tends to lower the land, opposed to frequent uplifts.
- (8) Illustrate by such studies as the Cypress Hills formation; the Selkirk Range, in British Columbia.

II.—RIVERS, VALLEYS, LAKES, AND SWAMPS.

A.—Supply of Water:—underground supply; run-off; variation in run-off; perennial flow; regulation of river volume; floods.

B.—Meaning of the following terms:—gorge; ravine; gully; canyon; gulch; glen; dale; dell.

C.—Divides and Valleys—

1. Divides separating river systems.
2. Subordinate divides between different branches of the same system.
3. Meaning of term "watershed".
4. "Streams carve the depressions along which they flow". Rain sculpture; the bad lands.
5. Erosive action of rivers—
    - (a) Degrading and aggrading of valleys.
    - (b) Pot-holes; swift-flowing streams.
6. Waterfalls and rapids.
    - (a) A degrading stream flows from strong to weak rocks; Niagara.
    - (b) Rapids; formed over dipping surface of durable rock.
    - (c) Joint-plane falls.
7. Young, mature, and old valleys.
8. River flood plains.
9. River terraces.
10. Deltas.
11. Alluvial fans.
12. Imperfect development of drainage—
    - (a) Lake basins formed by some interference with drainage; glacial invasion, volcanic craters, ox-bow lakes, alluvial cones, landslides, lava floods.

- (b) Most lakes are long because they occupy parts of river valleys.
- (c) Deltas tend to make lakes irregular; waves tend to straighten the shores.
- (d) Salt lakes:—Caspian Sea, Dead Sea, Great Salt Lake. Cause:—source of salt, failure to overflow, increasing saltiness.
- (e) Life history of lakes:—swamps caused during filling of lakes; peat bogs, lake swamps, lake shore swamps, tundra swamps, river swamps, arid land swamps.

III.—PLAINS, PLATEAUS, AND DESERTS.

1. Marine and coastal plains.
2. Lake plains: (1) the Red River Valley plains; (2) the Great Lake plains.
3. River plains.
4. Prairie plains; the three prairie levels.
5. Origin and nature of a plateau.
6. Life history of a plateau; gorges, canyons, mesas, and buttes.
7. Nature of deserts.
8. Wind action on deserts; sand dunes, sand storms.

IV.—MOUNTAINS.

1. Names applied to units of mountain form:—range, system, cordillera, ridge, peak, interior basin, park, water gap, wind gap, pass.
2. Cause of mountains.
3. Life history of mountains:—young, mature, and old mountains.
4. Brief study of the structure of the Rocky Mountains—
    - (a) Deposition period:—great depth of sediment, approximately 50,000 feet.
    - (b) Uplift period:—beginning of Tertiary.
    - (c) Erosion period:—includes glaciation.
5. Mineral products of mountain regions.

V.—VOLCANOES, EARTHQUAKES, AND HOT SPRINGS.

1. Life History of a volcano.
2. Earthquakes—
    - (a) Cause; characteristics; effects.
    - (b) Recording and locating earthquakes.
3. Hot springs; Banff springs; mineral deposits at surface.

VI.—GLACIERS AND THE GLACIAL PERIOD.

1. Mountain valley glaciers:—formation; movement; glacial erosion; moraines—lateral, medial, and terminal; outwash deposit; source of water, of sediment; rock flour; nature of deposit.
2. Continental glacier, or ice sheet (the Greenland Ice Sheet): extent; movement; ice-cap; rock material—on the surface, at the base; deposits at the margin; icebergs—causes, effects.
3. Surface forms due to glaciers:—kames; eskers; drumlins; rounded and fluted hills; U-troughs; giant kettles; lake basins.
4. The glacial period—
   - (a) Evidence of a glacial period in Canada, and in Alberta in particular.
   - (b) Effects of this ice sheet: (1) on the land surface; (2) on soil; (3) on streams; (4) on lakes.
   - (c) Meaning of the following terms:—drift; till, or boulder clay; glacial scratches.

VII.—ECONOMIC GEOLOGY OF ALBERTA.

Alberta produces at present over 90 per cent. of the total petroleum production of Canada. Several large natural gas fields exist in the Province. There are more than 15,000 square miles of bituminous sands. At Fort McMurray there are valuable beds of salt. Other minerals are found, as gypsum, mica, talc, bentonite, copper, gold, silver, iridium, and iron. 1,500,000 horse-power is available in our water power, while only 72,000 horse-power has been developed. There are over 1,000,000 million tons in coal reserves, with an annual production of over 5,000,000 tons.

A *selection,* to be determined by local conditions and time available, is to be made of the following topics. Other topics may be substituted or included, at the discretion of the teacher.

1. A coal-bearing formation.
2. An oil-bearing formation.
3. Building stone.
4. Gravel beds.
5. Placer gold.
6. Water power in Alberta.
7. Other mineral deposits of Alberta.
8. Cores from wells; diamond drills.

Note.—Field work is so valuable that it should be included in every course in geology. The following are some of the phenomena that are likely to be found within easy reach of a school:

1. Illustrations of weathering:—cliffs, ledges, boulders, old stone or brick buildings.
2. Nature of country rock:—in river valleys, railway cuts, quarries. In such places, stratification, joint planes, folding and faulting, and fossils, may possibly be found.
3. The soil:—characteristics and depth; soil of rock decay, or transported soil; study its origin in some cut.
4. River transportation:—road gutters, ploughed fields, small wet-weather streams, railway cut. Nature of action; load carried; disposition of load; result of removal. Young stream valleys; alluvial fans; deltas; walterfalls. The entire subject of river action and life history of valley may be built up around a field excursion to a near-by stream.
5. Shore lines:—lake shore, river bank, or shore of a pond. Action of waves; bars; wave-cut cliffs; small-stream deltas; shore swamps.
6. Glacial phenomena:—striae; till banks; scratched stones. Are pebbles or boulders foreign, i.e., unlike the country rock? Is till unstratified? Find cuts of stratified drift—evidence of water action. There may be moraines, kames, eskers, or drumlins.
7. Fossils:—gravel pits, quarries, coal-mines, bad lands, railway and road cuts, outcroppings. A study of fossils interprets the condition of the earth that developed a particular type.

Note.—As enrichment material, teachers who have both time and interest, *may* develop a unit on minerals.

Minerals are recognized by their physical and chemical properties; of these the more important are:

1. Composition:—elements present in the mineral.
2. Crystal shape.
3. Hardness:—ability of one mineral to scratch another. Scale: (1) talc (softest); (2) gypsum; (3) calcite; (4) fluorite; (5) apatite; (6) feldspar; (7) quartz; (8) topaz; (9) corundum; (10) diamond (hardest).
4. Streak:—colour of the powdered mineral.
5. Lustre:—metallic or non-metallic.
6. Cleavage.
7. Fusibility:—some minerals melt readily; others are nearly infusible.
8. Taste, smell, feel:—taste (salt); odour (arsenical pyrites); feel (graphite and clay).
9. Mineral deposits and veins:—how mineral deposits are worked.

GEOLOGICAL TABLE FOR ALBERTA.

Era.	System.	Group.	Formation.	Life Conditions.
CENOZOIC	Quaternary.	Recent.		Man assumes importance.
		Pleistocene.		Periodic glaciation. Great mammals, such as the mastodon, become extinct.
	Tertiary.	Pliocene.		Apthropoid apes appear.
		Miocene.	Hand Hills conglomerate.	Period of greatest mammals.
		Oligocene.		Modern mammals and birds develop.
		Eocene.	Paskapoo.	Ancient mammal types fade, and new ones come in.
MESOZOIC	Upper Cretaceous.	Montana.	Edmonton. Bearpaw. Belly River. Pierre.	Reptiles of great size and great variety. Plant material approximating tropical flora of to-day found as pertified wood (cinnamon).
		Colorado.	Benton.	
		Dakota.	Dakto (Blairmore).	
	Lower Cretaceous.	Kootenay.	Kootenay Coal Measures.	Flowering plants appear; ferns, cycads.
	Jurassic.		Fernie shale.	Time of toothed birds and flying reptiles.
	Triassic.		Shales.	Time of dinosaurs.
PALEOZOIC	Permian.		Upper Banff shale.	Time of amphibians.
	Carboniferous.	Mississippian.	Rocky Mountain quartzite. Upper Banff limestone.	Period of ancient sharks and crinoids.
		Pennsylvanian.	Lower Banff shale.	Rise of primitive reptiles and amphibians. Ancient coal-swamp floras.
	Devonian.		Limestones:— Lower Banff. Intermediate. Sawback.	Dominance of fishes, corals, and shelled animals.
	Silurian.		Halysites beds.	Rise of lung fishes and scorpions.
	Ordovician.		Graptolite shales. Goodsir shales.	Rise of shelled animals.
	Cambrian.	Upper Cambrian.	Ottertail limestone. Chancellor shales. Sherbrooke limestones. Paget limestones. Bosworth shales and limestone.	Dominance of trilobites.
		Middle Cambrian.	Eldon limestone. Stephen shale. Cathedral limestone.	
		Lower Cambrian.	Great White shale and limestone. St. Piran quartzite. Lake Louise shale. Fairview sandstone and conglomerate.	
PROTEROZOIC	Pre-Cambrian.		Hector shale. Corral Creek standstone.	Time of first invertebrates. (Note.—Conditions were such that evidence of organic life: (1) larval life, (2) dawn of unicellular life, before the Proterozoic Era has been obliterated.)

PHYSICS

PHYSICS 1.

The course is outlined here by reference to sections of the authorized textbook. The requirements of the course cannot, however, be satisfied by the mere exposition of the textbook. The course should be made practical by means of experiments and other classroom activities that will bring it into contact with the students' everyday experience.

TEXTBOOK: *Elements of Physics for Canadian Schools*: Merchant and Chant; revised by Lewis, Ainslie and Lang (1937)—Copp, Clark Company.

This is an enlarged and greatly improved edition of the *Ontario High School Physics* (Revised Edition) by Merchant and Chant.

In the following outline, references to the older book are made in parenthesis.

PART I.—INTRODUCTION: Chapters I-IV. (Chapter I.)

APPARATUS.

Balance. Metric and English weights.

Metre sticks or rulers with inches and centimetres marked.

Litre can and gallon or quart can.

Measure various quantities—linear, area, volume.

Express the measurements taken in one system in terms of the units of the other system.

Determine density of bodies by weighing and measuring for volume.

Show importance of measurements—automobiles, bridges, railways, monetary exchange, etc.

PART II.—MECHANICS OF FLUIDS: Chapters V-XIV. (Chapters X-XIV.)

APPARATUS.

Balance. U-tubes. Rubber membrane. Thistle tubes. Equality of pressure syringe. Cylinder and socket for Archimedes' Principle. Overflow cans. Catch buckets. Specific gravity bottle. Demonstration hydrometer—weighted wood. Hydrometer tubes. Air pump. Rubber balloons. Glass tubing—rubber tubing. Intermittent siphon. Barometer tube—mercury—J-tube. Florence flask.

Chapters V and VI (Chapter X).

Show equality of pressure—Figs 19 or 20 (87 or 88).

Show pressure due to depth—Fig. 28 (95).

Chapter VII (ChapterXI).

Determine buoyant force—Figs. 35 and 36 (102 and 103).

Chapter VIII (Chapter XII).

Use several methods to determine density. The above apparatus is sufficient.

Note: If a specific gravity bottle is not available, the density of a liquid may be determined quite accurately with a narrow-necked bottle.

Chapters IX, X, XI and XII (Chapter XIII).

Experiments shown in Figs. 43, 45, 46, 52, 64 and 67 (110, 112, 113, 111, 124 and 125).

Chapters XIII and XIV (Chapter XIV).

Show the simpler applications of pumps and siphons.

PART III.—MECHANICS OF SOLIDS: Chapters XV-XXV.

(Chapters II-IX).

APPARATUS.

Coin and card over glass. Apparatus as Fig. 109 (25). Collision balls. Any heavy body and thread—Fig. 111 (27). Metre sticks. Weights. A board. A block of wood. Pulleys.

Chapters XV and XVI (Chapter II).

Omit the more difficult calculations.

Chapter XVII (Chapter III).

Illustrate momentum—coin and card. Collision balls.

Illustrate inertia—heavy body and thread—Fig. 111 (27).

Illustrate independence of forces—Fig. 109 (25).

Chapter XVIII (Chapter IV).

Use metre sticks over a narrow edge and place weights to illustrate law of moments. Do not attempt composition of forces or Parallelogram Law.

Chapter XIX (Chapter V).

Compare gravity, cohesion and adhesion. Do not attempt calculations.

Chapter XX (Chapter VI).

Do not attempt Section 126 (54).

Use any heavy body supported by string. Then drop when string is slack and show how string breaks.

Bring out differences between potential and kinetic energy, and between energy and work.

Chapter XXI (Chapter VII).

Use a piece of board, a string and chalk to find C. of G. of board as in Fig. 126 (41). Show that board balances on C. of G.

Find C. of G. of metre stick with weights placed at different points.

Illustrate three states of equilibrium with an egg, a cone or any similar body.

Chapter XXII (Chapter VIII).

Use experiment of Fig. 138 (49).

Use a block of wood or a brick. Show that the coefficient is independent of the size of the surfaces in contact. Have block of wood slide in opposite directions and take average to allow for grain.

Show effect of lubricants.

Chapters XXIII, XXIV and XXV (Chapter IX).

Use a metre stick or any type of stick to illustrate the three types of levers and find their mechanical advantage.

Find the mechanical advantage of different combinations of pulleys.

Chapter XXV for reference.

PART IV.—SOME PROPERTIES OF MATTER:

Chapters XXVI-XXVIII (Chapters XV and XVI).

Apparatus.

Wide-mouthed bottles. Glass tubing. Rubber tubing. Thistle tube and membrane. Surface tension apparatus. Cohesion plates or pieces of lead. Capillary tubes and mercury. Bubble pipe. J-tube.

Show diffusion—gases where possible—any colored liquid in water—any colored solid which will dissolve in water.

Show osmosis—thistle tube and membrane, or use any type of dried fruit.

Show cohesion and adhesion—dip glass in water and in mercury. Show application of this in capillary tubes—apply to blotter, towel, water in soil, etc.

Use cohesion plates or pieces of lead.

Show surface tension. Use special apparatus or float a pin.

Blow bubbles. Show contraction forcing air out of pipe.

Account for spherical shape of bubbles and drops.

Pour water down the outside of a glass rod or wooden stick.

Show how hairs of a brush draw together when removed from a liquid.

Show how kinetic theory explains Boyle's Law.

Use J-tube to demonstrate Boyle's Law.

PART VI.—SOUND: Chapters XLIII-LII (Chapters XVII-XXI).

APPARATUS.

A coil spring, or a rubber tube that is very flexible and elastic.

A mounted string—any string instrument, such as a violin or guitar, will do.

Two matched tuning forks mounted on sounding boxes.

An air pump and receiver and bell.

Mailing tubes, cardboard, water containers.

A simple rotating machine with perforated disk. See Fig. 322 (204).

Rods of wood, iron, etc.

Wave Motion.

Demonstrate transverse and longitudinal waves, using a spiral spring or rubber tube.

Show that energy is always transmitted from one end to the other.

Demonstrate nodes and loops by placing riders on a vibrating string. See Fig. 335 (212).

Illustrate wave length, amplitude and frequency.

Show that all waves can be reflected and refracted. Illustrate.

Explain the equation $v=nl$.

Show the different types of energy which are transmitted by wave motion.

Sound.

Show how sound is always produced by vibrating matter.
Compare the motions of a vibrating rod producing a sound, the particles of air transmitting the wave, and the drum of the ear receiving the vibrations.

Show that a material medium is required for transmission—Fig. 304 (187).

Compare intensities of transmission through different media by placing the end of a wooden stick, an iron rod and a rubber tube to the ear and having someone strike or scratch the other end. Also illustrate by results with head under water, as compared with transmission in air.

Echoes.

Compare with reflection of water waves and reflection of light in a mirror.

Music and Noise.—See Figure 322 (204). Illustrate by difference in driving over a rough and on undulating road.

Limits of Audibility.—Illustrate by a rod with too low a frequency to hear but show that it produces ripples on surface of water.

Sympathetic Vibrations.—Use tuning forks of the same frequency on sounding boxes. Illustrate by a swing.

Resonance.—Use mailing tubes with one end in water. For open tube roll up a piece of cardboard, and telescope it into a mailing tube. Vibrate fork over end.

Forced Vibrations. Consonance. Vibrate fork and press against any rigid surface. Illustrate by sounding boards or boxes in musical instruments.

Determine pitch by siren. Figure 322 (204).

Musical Instruments.—In connection with all common musical instruments, have the students answer the following questions:

1. How is the sound produced?
2. How is the pitch determined?
3. How is the sound intensified?

PART VII.—LIGHT: Chapters LIII-LXV

(Chapters XXXI-XXXVIII).

APPARATUS.

Pin-hole camera. A simple photometer. Plane mirrors. Concave mirrors. One convex lens. One concave lens. Two 60° prisms. Paper can be used for a screen. One or two glass tumblers. Candles to use as sources of light and as objects.

If a rotating machine is available, get a Newton's disk to rotate on it.

Get some glass of different colors and show how light is absorbed as the colors are superimposed one on the other.

Compare the transmission of sound and light.

Illustrate differences in velocity of transmission. (The steam from a locomotive whistle is seen before sound is heard, etc.)

Show the umbra and penumbra in the sun's shadow cast by a stick or a post.

Make a pin-hole camera from a cigar box. Use a piece of frosted glass at the back.

Distinguish between intensity of illumination and illuminating power. Illustrate by noting effect on eyes as one moves closer to a bright light.

Prove Law of Inverse Squares, using a photometer.

Test laws of reflection in a plane mirror.

Show regular and irregular reflection—any highly polished surface compared with a similar dull surface.

Place an object between plane mirrors inclined at different angles and note the images.

Place an object between parallel mirrors and note the images as viewed over the top of one mirror.

Find the principal focus of concave and convex mirrors and lenses.

Show the images when objects are placed in different positions in relation to both the mirrors and the lenses.

Show that the real image can be focussed on a screen, while the virtual image can not.

Draw diagrams to explain the formation of the images and to show how the eye sees them.

Illustrate refraction with water in a glass and with prisms.

Show total reflection and explain its application in binoculars, rainbow, etc.

Explain power in a lens and show how the convex lens is used for a magnifying glass.

Explain the correction for short-sightedness, and long-sightedness.

Show how the convex lens is used in both the camera and the projection lantern to secure a real image.

Produce a spectrum and recompose the colors.

Explain the difference in the process of mixing colors and mixing lights.

PHYSICS 2.

This course consists of studies in Heat, Electricity and Magnetism, and other forms of Radiant Energy, and is based on the material set forth in Parts V, VIII and IX of the textbook. It is not intended that the method of the course should be solely, or even largely, textbook exposition, but rather that **demonstration** by the teacher, **experiments** by the students and **supplementary reading** should all find a place in the methods to be employed in the classroom.

While the material of Part IX forms a definite part of the course, the teacher will use his discretion in attempting to treat this material exhaustively in the classroom. A detailed mastery of this material will **not** be required for purposes of the Departmental examination. Students who show particular interest and special aptitudes should prepare demonstrations and reports on topics chosen from the material of Part IX, with the assistance of such demonstration and explanation as may be provided by the teacher.

TEXTBOOK: *Elements of Physics for Canadian Schools* by Merchant and Chant; revised by Lewis, Ainslie and Lang (Copp, Clark Co.).

EXPERIMENTAL WORK.

The following **experiments**, as listed by reference to paragraph numbers in the textbook, or otherwise, are to be performed by the students:

194-5, 200, 202, 206, 212, 215, 217, 224, 236, 256, magnetizing a steel needle and determining its polarity, 456, 459, 461, 474, 480, 510, 536, 539, winding an electro-magnet, wiring a bell to operate from either of two switches, 562, 566, assembling a "dissected motor," 601.

Note.—The experiments just mentioned are to be performed by small groups of students, with preferably not more than two students in each group. But every student is required **to participate in not fewer than fifteen experiments and to prepare permanent records in good form.** By this means, it can be arranged that dif-
equipment is used several times during the year.
ferent pieces of apparatus are in use at the same time and that all

READING.

The reading by the students of scientific books and articles is to be encouraged and made a definite part of the work of the class. The following titles are suggested for the classroom library. Each year as many new ones as possible should be added to this library.

Darrow: *Thinkers and Doers* (Silver Burdett & Co.).
Davies: *Inside the Atom* (Harper and Bros.).
Downing: *Our Physical World* (University of Chicago Press).
Sir James Jeans: *Through Space and Time* (Macmillan Co.).
Sir James Jeans: *The Universe Around Us* (Macmillan Co.).
Jaffe: *Crucibles* (Tudor Publishing Co.).
Haslett: *Unsolved Problems of Science* (Macmillan Co.).
Eddington: *Nature of the Physical World* (Macmillan Co.).
Eddington: *Science and the Unseen World* (Macmillan Co.).
Bawden: *Man's Physical Universe* (Macmillan Co.).

N.B.—See the list of reference books under "General Science" on page 28 of this Bulletin.

MINIMUM LIST OF REQUIRED APPARATUS

Heat.

Hydrostatic balance.
Dew Point apparatus.
Thermometer, No. A.
Ball and ring.
Hope's apparatus.
Davy's safety lamp.
Conductometer.
Ignition solution.
Calorimeter.
Condenser, No. C.
Flask, distilling, 500 c.c.
Shot or pieces of metal for specific heat experiments.
Florence flasks.
Glass tubing.
Rubber tubing.
Rubber stoppers.
Wide-mouthed bottles.
Capillary tubing.
Glass beakers.
Test tubes.
Copper gauze.

Magnetism.

Lodestone.
Some type of bar magnet.
U magnet.
Magnetic needle.
Dipping needle.
Magnetic compass, size D.
Iron filings, nails. Soft iron bar, etc.

Static Electricity.

Pith balls.
Electrophorus.
Electroscope.
Proof plane.
Hollow globe.

Current Electricity.

Demonstration cell.
Electromagnet.
Primary and secondary coil.
Induction coil.
Demonstration motor.
Dissected motor.
Telegraph key.
Telegraph sounder.
Telegraph relay.
Electrolysis apparatus.
Electroplating outfit.
Galvonometer or some other good type.
Dry batteries or storage battery or battery substitute.
Strips of copper.
Strips of zinc.
Sticks of carbon.
Sheet of lead.
Porous cups.
Glass battery jars.
Copper sulphate.
Zinc sulphate.
Sulphuric acid.
Manganese dioxide.
Powdered carbon.
Ammonic chloride.
Wire.
1½-volt miniature electric lamps.

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